2001-12

Comparison of Design-Build to Design-Bid-Build as a project delivery method

Allen, Linda N.

Monterey, California. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

COMPARISON OF DESIGN-BUILD TO DESIGN-BID-BUILD AS A PROJECT DELIVERY METHOD

by

Linda N. Allen

December 2001

Principal Advisor:	Jim Barnard
Associate Advisors:	Joe Angell, II
	Keith Molenaar

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** December 2001	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE: Comparison of Design-Build to Design-Bid-Build as a Project Delivery Method			**5. FUNDING NUMBERS**
6. AUTHOR(S) Linda N. Allen			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			**12b. DISTRIBUTION CODE**

13. ABSTRACT ***(maximum 200 words)***

This study evaluates the difference between the Design-Bid-Build (DBB) and Design-Build (DB) project delivery methods. The project delivery method defines the acquisition process, relationships, roles and responsibilities of the project team and the sequence of events to deliver the facility.

Southwest Division, Naval Facilities Engineering Command, (SWDIV), has been using both the DBB and DB project delivery methods for the past decade. The most recent four-year period has seen an increase in the use of DB project delivery. This research provides a definitive and comprehensive investigation into the comparative performance of projects delivered using these two methods. A comparison of cost, schedule and quality attributes of the two types of project delivery systems was completed using specific data from 110 military construction (MCON) projects.

This study included extracting all MCON projects from the financial information system (FIS) database for the period 1990-2000. The first DB project was delivered in FY 1996, therefore the study focused on MCON projects completed from FY96-2000. All completed MCON projects were used to compare performance of all projects to the focus of this research, Bachelor Enlisted Quarters, Category Code 721.

This study included interviews to verify the financial information system (FIS) data. A Survey questionnaire was distributed as the primary tool to collect data on quality performance. Several variables critical to project performance identified during interviews, survey questionnaires and data collected from FIS were also included in this study.

This research should help in understanding the two project delivery methods to help an owner better select the project delivery system most suited to their specific facility goals or criteria. Results and the level of confidence that surrounds specific findings are presented. This study provides quantitative data to support the selection of a specific delivery system and increase the understanding of the two project delivery systems performance.

14. SUBJECT TERMS acquisition, project delivery, design build, design-bid build, construction			**15. NUMBER OF PAGES** 99
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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COMPARISON OF DESIGN-BUILD TO DESIGN-BID-BUILD AS A PROJECT DELIVERY METHOD

Linda N. Allen
Civilian, Naval Facilities Engineering Command
B.S., College Misericordia, 1981
M.P.A., Golden Gate University, 1993

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN CONTRACT MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
December 2001

Author: Linda N. Allen

Approved by: CDR Jim Barnard
Digitally signed by CDR Jim Barnard
DN: cn=CDR Jim Barnard, o=Naval Postgraduate School, ou=Graduate School of Business and Public Policy, c=US
Date: 2001.11.12 10:47:23 -08'00'
Jim Barnard, Principal Advisor

Joe Angell, II, Associate Advisor

Keith Molenaar, Associate Advisor

Kenneth J. Euske, Dean
Graduate School of Business and Public Policy

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ACKNOWLEDGMENTS

I would like to thank my thesis advisor CDR Jim Barnard, and associate thesis advisors Dr. Keith Molenaar and CDR Joe Angell, II, my family and friends for their constant support as well as ROICC Miramar and my co-workers. Also, I would like to thank CAPT Mikal Nicholls for his EXCELent support and Doug Gransberg for his advice and guidance.

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I. INTRODUCTION

A. BACKGROUND

As defined by the Federal Acquisition Regulation (FAR subpart 36.102), Design-Build (DB) is a means of combining design and construction in a single contract with one contractor. The authority to use the two-phase DB method was promulgated in FAR Case 96-305 as a result of the enactment of Section 4105 of the Clinger Cohen Act of 1996, Public law 104-106. Specifically, FAR subpart 36.301 prescribes policies and procedures for the use of the two-phase DB selection procedures authorized by 10 U.S.C. 2305a and 41 U.S.C. 253m. The use of the DB process for military construction projects is authorized under Title 10 U.S. C., Section 2862, with permission of the Secretary of the military department concerned.

In contrast to DB, the traditional method of using Design-Bid-Build (DBB) entails issuing an initial contract for "architect-engineer services," as defined in 40 U.S.C. 541. The professional services of an architectural and engineering firm define the construction requirement (including the functional relationships and technical systems to be used, such as architectural, environmental, structural, electrical, mechanical, and fire protection), producing the technical specifications and drawings and preparing the construction cost estimates. The professionals who provide these services are licensed, registered, or certified to provide such services.

Upon completion of the architect-engineer contract, the construction contract is solicited for bid under procedures in FAR Part 14 – Sealed Bidding if the conditions in FAR 6.401(a) apply, except that sealed bidding need not be used for construction contracts to be performed outside the United States, its possessions, or Puerto Rico. The traditional approach of DBB is established under the Brooks Architect-Engineers Act (41 U.S.C. 541, et seq.)

B. PURPOSE

Southwest Division, Naval Facilities Engineering Command, (SWDIV), has been using both the DBB and DB project delivery methods for the past ten years, with a total Military Construction – Navy MCON (Military Construction) program averaging

approximately $200,000,000- $250,000,000 per year. The most recent four-year period has seen an increase in the use of DB project delivery, however, no definitive evidence has been assembled to compare the performance of DBB projects with DB projects. Therefore, a definitive and comprehensive investigation into the comparative performance of projects delivered using these two methods is required.

Additionally, the growth of DB and the limited existence of documented research with regards to the critical factors associated with the DB concept, as well as a lack of established uniform processes, necessitates a focus on these areas for structuring and effectively using DB. Critical factors associated with the DB concept must be identified to shape and structure a DB model diagramming the phases of the DB procurement method. This analysis will assist in determining if there are any fatal flaws or characteristics that might signify that DB is not the best method of project delivery or highlight problems or failures in the process.

C. RESEARCH QUESTIONS

The primary question: Is the Design Build construction project delivery approach a superior method of managing Navy Bachelor Enlisted Quarters construction projects? The subsidiary questions are as follows:

- What type of homogenous construction projects is representative of Naval Facilities Engineering Command, Southwest Division?
- What are the backgrounds and histories of DBB and DB construction management approaches?
- What are the comparative quality performances of projects using DBB versus DB?
- What are the comparative cost growths in the construction contracts for projects using DBB versus DB?
- What is the comparative schedule growth in the construction contracts for projects using DBB versus DB?

D. SCOPE AND METHODOLOGY

This research will evaluate the difference between the DBB and DB project delivery methods. The objective is to analyze executed projects in the MCON program to provide definitive, quantitative evidence to compare the performance of DBB projects with DB projects. The research will include conducting a detailed analysis of both project delivery methods by extracting project information from both the financial

information database (FIS) and subjective information from project managers and project users, and then developing project performance metrics. The research will be limited to a focus on Bachelor Enlisted Quarters, Category Code 721, that were funded by Military Construction dollars for new construction during the period 1996-2000.

A data query of the FIS for all Military Construction for new projects for the entire footprint of SWDIV from 1990 to 2000 was completed, revealing that the first DB project was completed in 1996. As a result, the research was then focused on DB and DBB projects from 1996-2000.

The data query resulted in a list of 110 projects with a cumulative value (from the 1391) of $1,096,521,000.00. The facility types included various category codes:

- Category 110 – Airfield Pavements
- Category 143 –Operational buildings
- Category Code 151/152 - includes pier repair and wharf repair
- Category code 179-40/55, small arms range, combat training pool
- Category 200 – Maintenance and production facilities
- Category 211 – Engine Test Cell, electronic facilities
- Category 390 – Weapons systems facility, aircraft systems facility (RDT&E), electronic facilities (RDT&E), propulsion facility, miscellaneous items and equipment facility
- Category 421 - Magazines
- Category 721- Unaccompanied personnel housing (BEQ's)
- Category 740-43 – Fitness Centers, gymnasium
- Category 740-74 – Child care center
- Category code 841- includes water treatment facility building, water storage tanks, and various other water systems

Several of the category codes cover multiple projects. Several dissimilar projects are categorized under the same category code. Table 1.1 depicts the projects by facility number under categorical codes and dollar value respectively.

CATEGORY	NUMBER	DOLLAR VALUE
110	4	14,340,000
143	13	69,050,000
151	11	264,581,000
179-40/55	4	18,460,000
200	16	271,148,000
211	8	35,046,000
390	7	35,440,000
421	5	37,146,000
721	20	277,890,000
740-43	13	47,960,000
740-74	7	20,850,000
841	2	4,610,000
TOTAL	**110**	**$1,096,521,000**

Table 1.1. Projects by Facility Number under Categorical Codes and Dollar Value.

The category codes 721, Unaccompanied Personnel Housing (BEQ's); 740-43, Fitness Centers; and 740-74, Child Care Centers are homogenous projects. BEQ's represent 18% of the total number of projects, and 25% of the total dollar volume of projects. Therefore, BEQ projects were selected as being highly representative of projects done by Naval Facilities Engineering Command.

E. ORGANIZATION OF STUDY

The data will be analyzed based upon the project delivery method (DB or DBB). Definitions of each project delivery system will be discussed further in Chapter II.

The project performance data will be detailed and rationale for any inferences will be explained. A summary of methods used to develop those inferences will be included in Chapter III.

The analysis of the project performance and an analysis of relative differences between projects delivered by DBB and DB will be explained in Chapter IV.

Chapter V will present the researcher's conclusions. This includes recommendations as well as cogent thoughts for implementing the results of this study in SWDIV's project delivery program policy.

II. DESIGN BID-BUILD AND DESIGN BUILD PROCESSES

A. INTRODUCTION

The Design-Build and Design-Bid-Build acquisition process offer significantly different approaches to managing building construction projects. While each process results in a completed project, they take fundamentally different paths to get there.

This chapter provides an identification of the process steps in each approach, provides an analysis of the implementation of each approach, and discusses the roles and responsibilities of the players involved to include the functions of the Procuring Contracting Officer and the Administrative Contracting Office.

B. IDENTIFICATION OF PROCESS STEPS

1. Phase I- Acquisition Planning: Mission or Needs Requirement

The Federal Acquisition Regulation (FAR) defines acquisition planning as the process by which the efforts of all personnel responsible for an acquisition are coordinated and integrated through a comprehensive plan for fulfilling the agency need in a timely manner and at a reasonable cost. It includes developing the overall strategy for managing the acquisition. (FAR, Part 7).

The acquisition planning stage for DB and DBB is the same except with a DB project the process is done once. For a DBB project, the team must go through the process twice: once for the Architecture/Engineering (A/E) contract and once for the construction contract.

The acquisition planning process in a DB project includes all the personnel involved with the project from conception to completion. The pre-award personnel and the post-award personnel are a part of the team. The team stays together throughout the life of the project. Conversely, in a DBB project the team comes together for the acquisition planning stage for the A/E contract, but may disperse in any of the phases. For example, personnel involved in acquisition planning may not be involved in the administration of the contract. The pre-award and post-award personnel may come together at a handshake meeting to pass the contract action from the pre-award side to the post-award team upon award of the contract. In a DBB project, the team that was

involved in developing the RFP for the A/E contract, may and often are, a completely different team for the construction contract. Figures 2.1 and 2.2 displays the DBB and DB process

The design-build process differs from agency to agency. The SWDIV process for DB consists of six steps as shown in Figure 2.2.

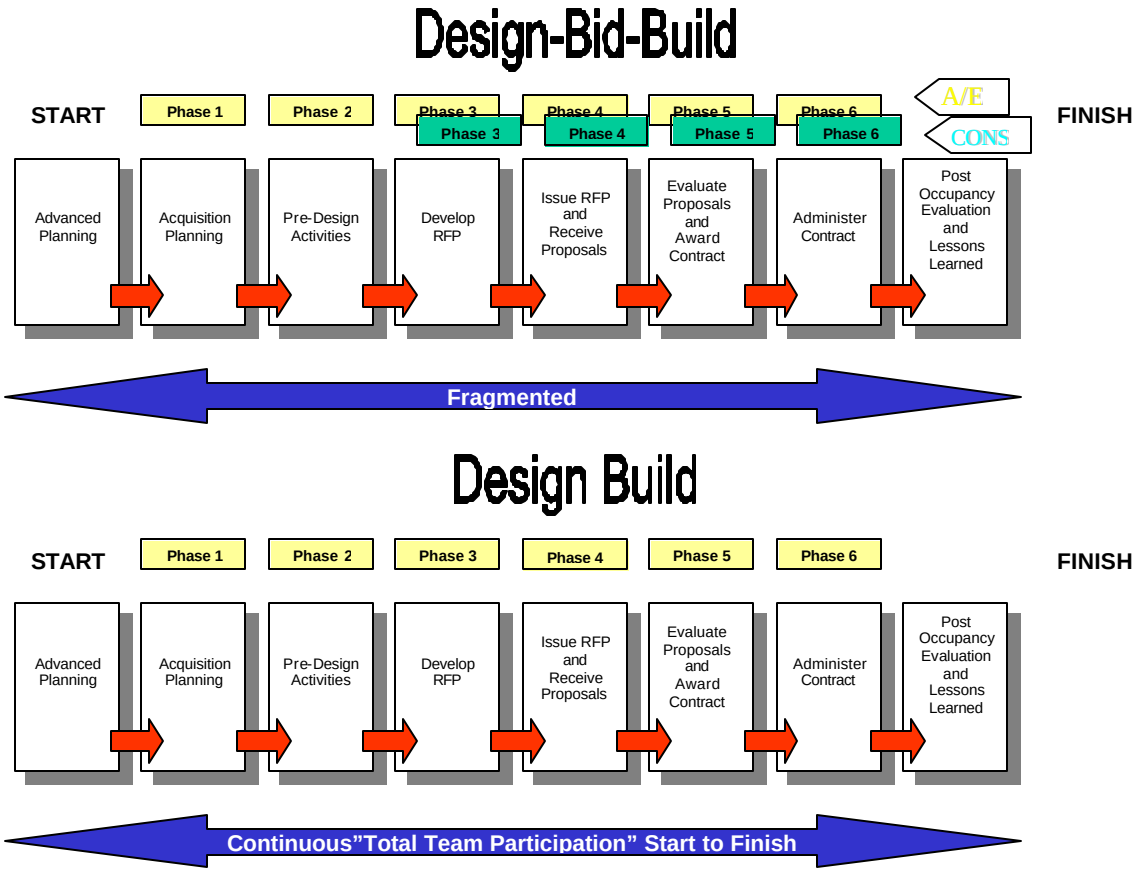

Figure 2.1. Depicts the Traditional Method of DBB.
Figure 2.2. Depicts the DB Process.

Phase I, or acquisition planning for DBB and DB, must succinctly define the *Mission or Needs Requirement.* The requirement and all the constraints and elements of that requirement must be fully understood and articulated. The project team must come to terms with what they want to achieve and they must be able to describe it to someone else who has no idea what the team is thinking. A big step in DB is the ability to describe

how you want the project to perform, rather than how it must be designed. By contrast, the DBB process must describe how the project must be designed.

The decision to use DB or DBB comes **after** a full analysis in the advanced planning stage of the need or requirement. A reason cited for choosing DB is the high importance put on "execution". It is thought the DB delivery method will ensure 100% execution of project dollars each fiscal year because a single contract is awarded quicker then the two contract actions required by a DBB process. Another reason for selecting a DB is contingency funds on MCON projects are for all intent and purposes non-existent. DB is seen as satisfying a mission for delivering a project with zero contingency dollars. Historically, the DBB process experiences several change orders to the contract.

A Customer Requirement Evaluation Form (CREF), records the preferences of the customer, which will be considered in selecting a contract vehicle for project delivery. The customer selects the criteria that are important to them. The criteria include price, speed of delivery and quality. If speed of delivery is ranked most important, then DB is often the project delivery method chosen.

Recent policy cited in the NAVFACENGCOM policy, "EXECUTION OF DESIGN-BUILD CONSTRUCTION", dated 07 August 2000, states that DB is the procurement strategy of choice. However, the most appropriate, "best value" procurement strategy should be selected for each project. DB, as a tool, should be part of an overall balanced program acquisition strategy. Projects should be reviewed and an acquisition plan formulated based on the specifics of each project.

The request for proposal (RFP) and statement of work (SOW) are conceptualized in phase I and completed in phase II. The DBB and DB projects take into account different considerations. For example, consideration is given to the cost of construction and funding available, design criteria, complexity, specifications and construction details for a DB project. The DBB project criteria depend on whether it is for the A/E contract or the construction contract. For example, the design criteria is essential in the A/E contract but not for the construction contract. Environmental considerations, available pool of skilled and interested contractors, agency knowledge and experience, project design and construction schedule, building type e.g. "cookie cutter" type buildings,

schedule and time assessment, and the need to consider the customer's desires and commitment are integral to defining the mission or need and must be considered in both project delivery types.

Inclusive to **all** phases in the DB acquisition model is the team of players. From conception, a typical team might include or be comprised of members from planning and design, contract specialists and engineers from the field or activity that will administer the contract, administrative contracting officer (ACO), as well as their pre-award counterparts, procuring contracting officer (PCO), environmental representatives, housing representatives if appropriate, comptroller, legal representation, and customer representation. The DBB process includes several different teams, who depart membership at any given phase depending on what part of the process or what contract is in process (A/E or Construction).

In the DBB process, the pre-award team members are distinct and separate from the post-award team members. The PCO function is performed without an interface with the ACO or other post-award members.

Mr. Jim Ward, SWDIV's Chief Architect, stated that once the team members got onboard a DB project, it is generally not a good idea to get off. He described the team members staying together as the "corporate" approach. He stated that it was extraordinarily important to the success of the DB process. The old way or the "piecemeal" approach (lineal execution) with each individual team member finishing his/her part of the process before handing if off to the next person promised a spotty process, overly focused upon small pieces of the puzzle. [Ref. 17: p. 5].

The summation for DB and DBB in the mission and needs requirement phase can be stated as a sound engineering analysis with consideration of input from all external and internal sources.

2. Phase II- Pre-Design Activities

During this phase the decision has been made to use DB or DBB as the delivery method or tool.

The RFP and SOW are further developed and defined. The RFP must be fully understood by all parties. The RFP should contain, but is not limited to, price schedules,

description of project conditions and site data, performance-oriented technical specification, project functional requirements and standard solicitation provisions and contract clauses. In the traditional DBB project delivery method, the RFP contains prescriptive specifications and includes one hundred (100%) plans and drawings on which the construction contractors propose.

The RFP must include a clear and concise concept narrative. The DB process should be explained in the narrative. The RFP should delineate all the routine instructions and guidance, but in particular in the DB scenario, the descriptive narrative of the project is critical. The traditional RFP for a DBB process is very prescriptive for the A/E contractor and the Construction contractor. The narrative is not as critical because the RFP is prescriptive and for the construction contract includes complete plans and specifications. In the DBB method, the problems occur when the plans conflict with the specifications or vice versa. The DB project method eliminates this problem because the specifications are performance specifications and the contractor is responsible for the drawings and design.

The acquisition plan for a DB project can be refined with consideration to fast-track requirements and project schedule. This is a benefit of using the DB project delivery method. The traditional DBB method does not allow for fast tracking and trade offs for schedule performance.

For both project delivery methods, DB or DBB, consideration should be given to exchanges of information with industry prior to issuance of the RFP. A draft RFP should also be considered. In accordance with FAR 15.201, exchanges of information among all interested parties, from the earliest identification of the need or requirement, are encouraged. This subpart goes on to say that the purpose of exchanging information is to improve the understanding of Government requirements and the skill base of industry, thereby allowing potential offerors to judge whether or how they can satisfy the Government's requirements. Identifying the skill base is particularly important for a DB project. The DB project delivery method is somewhat new and experience with the DB process can make the difference in the success of the project. Agencies are encouraged to promote early exchanges among industry and the program manager, contracting officer,

and other participants in the acquisition process. Exchanges help to identify and resolve concerns regarding the acquisition strategy, including the proposed contract type, terms and conditions, the acquisition planning schedule; the feasibility of the requirement including performance requirements, statements of work, and data requirements. Exchanges identify the suitability of the proposal instructions and evaluation criteria, including the approach for assessing past performance information; the availability of reference documents; and other industry concerns or questions. Since DB is a relatively new project delivery method, exchanges are extremely important.

Since DB, as a method of project delivery, is somewhat new to industry, an advisory multi-step process should be considered in this type of procurement. As described in FAR 15.202, the advisory Multi-Step process allows the agency to publish a pre-solicitation notice (FAR 5.204) that provides a general description of the scope or purpose of the acquisition and invites potential offerors to submit information or questions. This allows the Government to advise the offerors about their potential to be viable competitors. A short list of contractors might be considered in this phase. During formal or informal acquisition planning, adherence to FAR subpart 36.3-Two-Phase Design-Build Selection Procedures should be followed.

In contrast to the DB process, the DBB process has a separate Architect/Engineer team employed by the owner to prepare design documentation (Drawings and Specifications). The owner would then advertise to Construction Contractors who bid on the completed design and specifications.

3. Phase III-Develop RFP: Source Selection Plan

As stated in FAR 15.302- Source Selection Objective, the objective of source selection is to select the proposal that represents the best value. The DB method allows the Government to select the contractor whose proposal represents the best value to the Government. In contrast, the DBB/IFB project delivery method only ensures the contractor selected represents the lowest price. Low price does not equate to best value. The DBB/RFP may include criteria for best value but certainly not design criteria.

The DB process mandates that an evaluation team be established with selection of participants that are experienced and appropriate for the particular acquisition. A critical

part of the solicitation requirements is the establishment of the evaluation factors and sub-factors. The selection must be based solely on the factors and sub-factors contained in the solicitation (10 U.S.C. 2305(b)(1) and 41 U.S.C. 253b(d)(3)). The responsibilities for source selection are delineated in FAR subpart 15.303- Responsibilities. Evaluation Factors and Significant Sub-factors are explained in FAR subpart 15.304. For the purposes of this model, the significance of the evaluation factors and sub-factors must be fully understood by the source selection team. Evaluation criteria are not a consideration for the DBB/IFB process and the evaluation is confined to the determination of responsiveness and responsibility of the contractor with the lowest proposal.

Some of the evaluation criteria that might be considered for a DB project are site design, facility design, systems design, mechanical design, electrical design, project management, experience, past performance, quality, safety, and experience criteria for critical personnel who will be responsible for project execution. Criteria should be prioritized or weighted. Often in the DB process, criteria are listed as nice to have and not weighted. Cost or price will always be a factor for evaluation. In the DBB process, price is the prime discriminator if the solicitation was put out as an IFB.

A pre-proposal conference is extremely important in the DB project delivery method. The RFP is critical in the DB process and a pre-proposal conference allows for questions and answers or clarification of the RFP narrative performance description.

It is absolutely essential that the DB project team formulate the RFP in a manner that clearly describes what the contractor must submit as a part of their proposal, and what must be provided in the form of design and construction documentation after the award of the DB contract. This is obviously different in the DBB project since the construction contractor is not responsible for design documentation.

The DB RFP should only ask for that amount of information which is absolutely necessary for the proposers to develop a cost proposal. The contractors absorb the costs for proposal preparation. The less that is required in the form of an Offeror's proposal the better, provided that there is sufficient information to evaluate technical engineering criteria by the members of the project team. Each project delivery method results in proposal costs but the DB proposal is expensive because it includes the design effort.

The DBB construction proposal does not since the contractor was given complete design and specifications.

The DB and DBB contractors should attend a site visit. In actuality, a site visit by all DB proposers should be mandated. It is critical that the DB contractors walk the entire site and ask questions or voice concerns. This is particularly important for DB renovations. If possible, destruction inspection should be allowed. The contractors should be allowed to see what is behind that wall, ceiling, floor, roof, etc. SWDIV schedules the site visit at the end of the first week after advertisement of the RFP for a DB project. [Ref. 18:p. 16] The site visit may not be scheduled as quickly for the DBB project. The DBB contractor is not responsible for what is behind the wall, ceiling, floor, roof, etc.. They are informed by the design drawings provided.

The DB proposers should then be given approximately three additional weeks to pull together their proposals. Depending on the complexity of the project, the time may be reduced to two weeks after the site visit, or for more complex projects, a significantly longer period to prepare their proposals may be allowed. Usually six weeks, including the week before the site visit, should be more than adequate. [Ref. 18:p. 16] The DBB construction proposers are given approximately the same amount of time to prepare their proposals and they are not responsible for the design. It can be seen that the DB process is a faster track project delivery method. The DBB requires the complete design cycle by the A/E prior to the construction contract cycle.

To mitigate costs for the DB contractor, the RFP should identify the minimum level of design documentation completion that will be required after award, including incorporation of shop drawings into the final set of design documentation. Only the documentation absolutely necessary to facilitate coordination and construction of work should be required. [Ref. 18:p. 14]

The RFP for a DB project should specifically require identification of a “Designer of Record”. This “Designer of Record” will ultimately be responsible for the coordination of all the trades and engineering disciplines and for review and approval of shop drawings. [Ref. 18:p. 17]

The DB RFP also identifies the manner in which design and construction will be monitored. If the project allows for the contractor to submit partial design documentation in order to support the work that is about to be constructed in the field, this is referred to as "fast-tracked". The ability to "fast track" makes the DB project delivery method attractive. The DBB project delivery method does not have the "fast track" feature. You can accelerate a DBB construction project, but at a price.

The DB RFP should stipulate the type of reviews that will be conducted. Over the shoulder reviews are preferred because they expedite the process. The old fashioned way, or DBB way of making the contractor wait for "review comments" and the associated delays related to responses and re-reviews is not desirable. Fire systems are an example of a mandatory review because they deal with life and safety but overall, formal reviews are detrimental and not within the DB concept.

The DB RFP should clearly state what is acceptable and what is desirable with regards to the schedule for the completion of the project. If the proposer knows what is acceptable and what is desirable, they will have a better understanding of what is required to improve their score during the evaluation of proposals.

Attention must be given to the description in the DB RFP of what "acceptance testing" criteria means since DB specifications are predominately "performance based" requirements. The DB RFP should clearly state the levels of performance that will be expected by the end product.

4. Phase IV- ISSUE RFP

The RFP for DB and DBB projects should be issued in accordance with procedures delineated in FAR Part 5 – Publicizing Contract Actions. The policy is to increase competition, broaden industry participation in meeting Government requirements and assist small business concerns.

SWDIV has awarded several DB Multiple Award Construction Contracts (MACC's). The solicitation resulted in several contractors selected based on best value. These selected contractors compete amongst each other for requirements under this contract. These contractors have demonstrated DB capabilities. The competition is narrowed, but it allows the Government to do business with contractors with specialized

experience and exceptional track records and who want to succeed to secure work in a competitive market. SWDIV has several DB MACC's including an 8(a) DB MACC.

5. Phase V- Evaluate Proposals and Award

In the interest of saving time the evaluation of DB proposals should begin immediately. The evaluation process for the DB project takes considerably more time then the DBB evaluation. A DB Pre-Evaluation meeting may be conducted. The evaluation is an assessment of the proposal and the offeror's ability to perform the contract successfully. The proposals should be evaluated solely on the factors and sub-factors specified in the solicitation. The relative strengths, deficiencies, significant weaknesses, and risks shall be documented in the contract file in accordance with FAR subpart 15.305- Proposal Evaluation. Applicable business clearances should be prepared.

The Source Selection Board for the DB project should make the decision on whether to award on the basis of the initial proposal, whether to award without discussions, and whether to establish a competitive range and conduct written or oral discussions. The FAR subpart 15.306- Exchanges with offerors after receipt of proposals, discusses clarifications and award without discussions, communications with offerors before establishment of the competitive range, the competitive range, and limits on exchanges. The DBB project may not include exchanges if the solicitation was put out as an IFB.

The FAR no longer refers to best and final offers but rather to final proposal revisions. This takes place only after discussions or as a result of discussions. Proposal revisions are discussed in FAR subpart 15.307. Offerors shall be advised that the final proposal revisions shall be in writing and that the Government intends to make award without obtaining further revisions.

An offeror who has been eliminated from the competitive range or whose proposal will not be considered may request a debriefing prior to contract award. The FAR subpart 15.505- Pre-award Debriefing of Offerors, explains the process. A debriefing is critical to the DB offeror. It is in the Government's best interest to address any deficiencies to position contractors to be competitive in the next acquisition offering. A broad and competitive DB contractor base is desirable to ensure the Government has a

pool of competitive contractors who have the experience and expertise to offer the Government the "best value".

The process for the traditional DBB/IFB is to award to the responsible bidder who proposes the lowest construction contract price. In either the DBB IFB or RFP method, the owner tells the proposer exactly what he wants. Thus, there is no room for the contractor to suggest improvements to the design. The only acceptable design and construction approach is whatever the A/E provides in the contract documents.

6. Phase VI- Post-Award Contract Administration

In the traditional DBB method, a hand off meeting is coordinated between the ACO and PCO. In the DB method, the ACO and PCO should have been on the same team from the beginning of the project so that after the award, the handshake meeting is really a transition to the final phase. This usually takes place in conjunction with a pre-design conference that establishes the review of the documents, discusses environmental considerations, project schedule, standard provisions, payment process and approval, technical, quality, cost, and schedule goals of a project, and partnering between owner and contractor. In the traditional DBB process, the handshake meeting is often the first time the PCO team has come together with the ACO team. Often the handshake meeting only includes the contract members. The ACO team is usually unaware of who all the players on the pre-award team were.

Partnering for DB and DBB projects should be done at the onset of the contract. Partnering should include all the team players. A partnered DB project allows for critical communication and helps establish trust. Since the DB project is performance oriented, it is requisite that the lines of communication be kept open and flowing. Partnering is equally important in a DBB project but often the A/E takes a more passive role since they have already completed their design even though their services are critical for the post construction services. Any Alternate Dispute Resolution (ADR) provisions may be discussed in the partnering sessions.

At project completion, for the DBB process, a separate evaluation should be input into the ACOE database for Architectural Engineering Evaluations (ACASS). The DB and DBB contractors should have an evaluation competed and entered into the ACOE

database for construction contract evaluations (CCASS). This is extremely important for the contractor and the Government. The contractor can use their evaluations to support past performance and experience criteria. The Government can check the CCASS database to ensure the contractor is a top performer with requisite experience.

C. ANALYSIS OF IMPLEMENTATION

The policy and guidance for the application and execution of DB as a project delivery method for construction contracts is established under NAVFACENGCOM HEADQUARTERS policy memorandum EXECUTION OF DESIGN-BUILD CONSTRUCTION, dated August 7, 2000.

Before implementing a DB strategy, the procurement should be assessed to determine if DB would provide the "best value". The following checklist must be completed before a decision to use DB is made.

- The construction is not extremely complex or unique and industry standards exist
- The design of the project, to be used in a solicitation originally planned as Design-Then-Construct, is less than 35 percent before conversion to DB
- The use of DB does not significantly impact competition (e.g., the project value is large enough to warrant contractor proposal preparation costs)
- A different acquisition tool will not produce better contract pricing, life cycle costs, and overall time savings
- National Environmental Policy Act requirements are complete or limited and do not require a significant level of design prior to contract award
- The use of DB does not adversely impact overall program execution goals for small business concerns (8(a), etc.)
- The client accepts the use of DB as an acquisition strategy

Implementation at SWDIV differs from area focus team and field offices. In some cases the same type of acquisition, for example BEQ's, are solicited differently. The RFP or the front end is not standard and may require a completely different design cycle.

Throughout the process the DB contractor must be treated as a team member. If the DB contractor is treated like a DBB contractor of the past, Requests for Information (RFI) will be seen. RFI's are indicative of a DB contract in trouble. Trust must be a two

way street in a DBB or DB project but trust is CRITICAL in the DB project delivery method.

One method of achieving full participation and facilitating a trust relationship in a DB project is by implementing "Pre-Work meetings". This is the very first meeting among all the team members. [Ref. 18:p. 26]

At the Pre-Work meeting, many of the team members are seeing the proposed design solution for the very first time. Possibly two concerns will be raised: 1) The proposed design solution will not match the requirements of the RFP exactly, and 2) Many people will see some things that need to be fixed. These things are better addressed at the beginning of the contract than at the end. [Ref. 18:p. 26]

D. ROLES AND RESPONSIBILITIES

The project team on the Government or Owner's side for a DB project must include members from the following: Design, Contracting, Project Management, Construction technical representatives, legal, and the customer and/or tenants. The contractor's team includes the following: Builder, Designer-of-Record, Consultants, Construction Representative, Design Administrator, Suppliers, and Subcontractors. This list can include any others who may contribute to the team.

The owner's role is to establish and communicate objectives, which include cost and performance and the function and appearance of the project. The owners must ensure compliance with authorized funding or cost appropriations. The owner must also ensure that all statutes, policy, and federal regulations are adhered to. Ideally the owner will empower the contractor and designer-of-record, facilitate the progress of the project, and equitably deal with any liability issues. [Ref. 18:p. 26]

The contractor must ultimately provide a design that is responsive to the RFP. The contractor must ensure that a design quality assurance (QA) and quality control (QC) plan is established. The contractor must communicate with the owner to ensure any changes, such as unforeseen conditions, are brought to the attention of the owner. The project should finish on time, and on budget. Teamwork and communication are necessary for a successful project.

E. FUNCTIONS OF THE PCO AND ACO

The functions of the PCO are well defined in the process above. However, in a DB or DBB project, it is extremely important that if the contract is to be awarded by a PCO and then administered by an ACO, the ACO must be a part of the project team from inception.

Often the ACO can bring invaluable lessons learned that should be considered early in the acquisition process. If the ACO is not a part of the team, the SOW and RFP may contain errors or omissions that could have been avoided.

The PCO and ACO should be trained in the DB process as it differs significantly from the DBB process.

The PCO and ACO for any project delivery method, is responsible for ensuring all necessary actions for effective contracting are followed as delineated in FAR 1.602-2 and that requirements and sufficient funds are available for obligation as defined in FAR 1.602-1 (b).

F. CHAPTER SUMMARY

Depending on what project delivery method is chosen as the acquisition process, roles and responsibilities of team members and the sequence of activities is different. It is important to understand the process steps to effectuate a successful project.

This chapter provided an identification of the process steps, an analysis of implementation, a discussion on the roles and responsibilities of team members and the functions of the PCO and ACO. The regulatory framework, which governs DB and DBB projects, was provided to differentiate the different guidance for each type system.

III. PERFORMANCE METRICS

A. INTRODUCTION

In this chapter the researcher presents the key performance metrics used in this research study. Assessment of any project involves the tracking of three key metrics: cost, schedule and performance. In conducting this study, the researcher explored the various metrics used within the construction industry to capture these key metrics as described in this chapter.

B. DEFINITION OF PERFORMANCE METRICS

The construction industry recognizes several standard metrics to measure project performance. Several indices are required for an authoritative comparative analysis. In the area of "project cost", the construction industry's key metrics are as follows.

1. Cost Performance/Cost Growth (CG)

Cost Performance/Cost Growth (CG) measures the percentage increase of a construction contract amount from its award price to the total final price. The total final price is normally the original contract price plus any change orders, deductive or additive, that occur during the period of the contract.

Cost growth is expressed by the following equation: CG=(FC-AC)/AC, where CG = Cost Growth (percent), AC = Award Cost ($), FC = Final Cost ($). "If CG is high, several inferences can be made. In a DBB project, the quality of the design could be poor, requiring numerous change orders to correct design errors and deficiencies. A high CG could also indicate a major unforeseen site condition that gravely affects the contractor's production, which once again potentially indicates inadequate site investigation by the designer during the design phase. A negative CG, for example, the final amount is less than the original amount, indicates that the owner failed to scope the magnitude of the project properly and tied up working capital unnecessarily. While it is always desirable to complete a project below its estimated budget, committing unneeded funding to a project reduces the total benefit to the taxpayer when taken in the context of an agency's entire capital improvement program." [Ref. 7:p. 10]

In the area of "project schedule," industry typically uses the following key metrics.

2. Schedule Performance or Time Growth (TG)

Schedule Performance or Time Growth (TG) measures the increase or decrease in a contract's life. Construction contracts have a contractual period of performance or a finite period of execution that defines the schedule for project delivery.

TG is expressed as follows: TG = (FT-OT)/OT, where TG = Time Growth (percent), OT = Original Contract Time (days), FT = Final Contract Time (days).

3. Engineer's Estimate (EE)

The Engineer's Estimate (EE) or estimated program amount are on the 1391 funding authorization and the Award Cost (AC). NAVFAC programs or authorized projects are based on the EE from the 1391.

4. Award Growth (AG)

Award Growth (AG) is the difference between the value of the EE and the AC, for example, the award cost or NAVFAC's estimate of project cost tempered by competitive market forces. Award Cost is used to measure the change in project financial expectations.

AG = (AC – EE)/AC, where AG = Award Growth (percent), EE = Engineer's Estimate ($), AC = Award Cost ($). This metric provides an interesting view of the Government's ability to forecast the cost of military construction. As a project proceeds from concept to completion, the owner's commitment to actual delivery becomes greater and greater. If the owner underestimates the project's cost in the early stages, that owner is liable to be more willing to pay an inflated price for the project as it draws closer to completion. It is very important that the owner be able to develop a good cost forecast immediately after design is complete so that a project that is marginally feasible is not awarded for construction. A high AG indicates the potential that NAVFAC will build projects that are economically unjustified merely because the project has been authorized and a commitment to project delivery has been made.

The next set of indices is based on the concepts of earned value and dollar placement. Earned value measures is the yardstick used by public owners to make

periodic partial payments to contractors for work satisfactorily completed. NAVFAC utilizes progress payments for fixed price construction contracts. The Government makes progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meet the standards of quality established under the contract. [Ref. 7] Earned value measures the speed with which a contractor can earn the full contract amount. [Ref. 29] Dollar placement is the average earned value over a specific portion of a project's life cycle. While earned value is normally not applied to NAVFAC design contracts, the concept can be extended as a means of measuring design contract performance in terms of a cost/time index.

Three metrics relating to dollar placement are used:

- Design placement (DP) is the average daily cost of design contract DP = DC/DT, where DP = Design Placement ($/day), DC = Design contract cost ($), DT = Design contract time (days)
- Construction placement (CP) is the average rate at which the construction contractor earns value over the entire period of the construction contract CP = FC/CT, where CP = Construction Placement ($/Day), FC = Final construction contract cost ($), CT = Construction Time (days)
- Design-construct placement (DCP) is the sum of the design contract and the construction contract divided by the total time period between the start of the design contract and the completion of the construction contract DCP = (DC + FC)/DCT, where DCP = Design-construct placement ($/day), DC = Design Contract cost ($), FC = Final construction contract cost ($), DCT = Design-construct time (days)

DCP measures not only the aggregate of design and construction but also the impact of the period between the two phases during which the project is advertised and awarded. It may happen that a project is designed but the construction portion is not authorized and the design languishes on the shelf. This metric might also allow the analyst to draw inferences about the efficiency of the regulatory requirements surrounding the project's award. [Ref. 7:p. 10]

Construction Placement tends to work in an opposite fashion to CG or TG.

A high rate of construction placement indicates an efficient and effective construction management system. If two contractors were doing identical lump sum projects in identical environments, the one that finished first would have incurred the least cost, and this would be indicated by a higher

> rate of CP. The same concept can be applied to designer. The owner's ability to manage both design and construction can be measured by DCP using the same theory. [Ref. 7:p. 11]

The U. S. Army Corps of Engineers uses CP as one of its fundamental project performance parameters and has more than 30 years of experience with its use. [Ref. 7:p. 11]

The final set of metrics is based on the cost to furnish a single unit of capacity in a given class of facilities. In this thesis, the scope of study is limited to BEQ's. For vertical projects, in which BEQ's fall, the most appropriate measurement is cost per square foot of finished facility. NAVFAC uses this type of data to complete conceptual estimates. A number of large public agencies, such as NAVFAC and the U.S. Air Force, for example, routinely use the database maintained by the R. S. Means Company of Kingston, Massachusetts to develop programming level estimates for large vertical construction projects. [Ref. 7:p. 11]

Delay costs can be analyzed individually for BEQ projects "if" the modification included a purpose code or description defining the change as a delay. The delay could be attributable to the Government, but very often the modification will include time but no dollars. "Time is Money", is a true axiom but hard to quantify in direct dollars in Government change orders. The metric that includes this cost is DCP.

The rate assessed for liquidated damages are included in the solicitation and the construction contract. The time as elapsed in calendar days would be captured by the metric TG. Liquidated damages are noted by a purpose code on the modification to the contract. Liquidated damages are assessed for the contractor's failure to complete the contract within the time specified, or within such time as may be extended by the change order, the duration in elapsed calendar days and the daily amount of liquidated damages and are addressed in the construction contract. Since liquidated damages assessed results in a deduction to the contract price, the modification or change orders must be accounted for in any CG metric.

The rate of change order and descriptive type are analyzed as a percentage of CG for the BEQ projects only. The ability to ascertain the various causes or conditions for

change orders is captured by the purpose code on the construction or design modification. The analysis is limited by the accuracy of the information input into the FIS database.

A claim against the Government is ascertained by the purpose code on the modification. The analysis is limited to the BEQ's projects. The accuracy is dependent upon the correct input of the purpose code and description in the FIS database. Claims are defined as a claim submitted with regards to FAR clause at 52.233-1 Disputes, in accordance with procedures and requirements under the Contract Disputes Act of 1978, as amended (41 U.S. C. 601-613) (the Act).

In the area of "project performance, Quality Measurements are defined as the degree to which the facility meets the expected facility requirement. The measure of quality is based on a maximum score of 10 on a subjective rating scale. Each measurement compares the actual performance against the facility user or owner's expectation of the BEQ. Quality surveys were also collected for family fitness centers and day care centers. These are all vertical projects, homogenous in that they are all like projects. Individual quality scores, based on a maximum of 10, were used for primary univariate comparisons.

Quality was measured in several areas. The facility maintenance or performance measure is based on the difficulty of facility startup, the number and magnitude of call backs, and the operation and maintenance costs required for the building. This measurement is turnover quality (TQ) of the facility, not to be confused with poor facility performance.

TQ = Qstart up + Qcall backs + Qoperation and maintenance. Qstart up is the difficulty of the facility startup process, Qcall backs is the number and magnitude of call backs during the turnover process and Qoperation and maintenance is the achievement of expected operation and maintenance costs for the facility/site. Each of these was scored on a scale of 10. Aggregate scores were used as summary metrics for univariate comparisons. This score combined individual ratings received for facility startup, the number and magnitude of call backs and the operation and maintenance cost scores for the building. The maximum score of 30 was possible for turnover quality. [Ref. 9:p. 80]

Systems quality (SQ) measures the performance of the envelope, roof, structure and foundation; the interior space and layout; and environmental systems. System quality measures whether or not these specific systems meet, exceed or do not meet the expectations of the owner.

SQ = Qersf + Qis&lo + Qenvironment. Qersf is the quality of the envelope, roof, structure and foundation systems, Qis&lo is the quality of the interior space and layout and Qenvironment is the quality of environmental systems such as the lighting, heating, ventilating or air conditioning. Each of these was scored on a scale of 10. A maximum score of 30 was possible for SQ. [Ref. 8:p. 80]

Equipment quality (EQ) is the quality of the process equipment in the facility. The equipment quality includes such items as the computer systems to run the systems included in the building.

EQ = Qprocess equipment & layout. Qprocess equipment & layout is the quality of process equipment if it was included in the facility. Process equipment and layout was based on a maximum score of 10.

C. SUMMARY OF USAGE, INTERPRETATION, AND LIMITATIONS

Performance metrics are useful to help evaluate and compare the DBB and DB project delivery methods. A comparative performance analysis of all the projects in the SWDIV database provides a comprehensive baseline that can be used to develop future acquisition strategies. All projects in the SWDIV database funded by MCON dollars were included in the analysis of CG and TG.

This research is limited to a comparison of CG, TG, and various quality measurements. It is recognized that several other variables that may potentially influence project performance are not included in this study. Some of those variables might include modifications not systematically recorded or input into FIS with data errors. The effects of various subcontractors, such as mechanical or electrical, which could be a significant percentage of the total project scope are beyond the scope of this research.

The comparisons do not consider any processes other than design and construction processes. Procurement, administration, resource leveling, environmental

planning, facility planning or any other owner driven processes are not a part of this research.

The quality of the data is recognized to be more subjective. Depending on the respondent's role, personnel feelings or expectations could come into play in the quality response. Quality is analyzed on a univariate level. The respondents to the survey were asked to rate performance on a fixed numerical scale from one to ten indicating low, medium or high. Qualitative variables such as prior expectations, or bad experience were not collected. Therefore, quality comparisons were difficult on a multivariate basis. Koncher (1997) recognized this as did Corbett (1997). Koncher's study used a Quality Index and a Quality Grade as a means of quantifying quality on 301 completed projects of various types. Corbett's study was similar and was based on 21 completed industrial projects.

Project timelines are different depending on project delivery methods. Several interviews revealed that in some DB projects very little design was completed prior to selecting a contractor. However, in other instances, substantial design had been completed and provided to the contractors. The disparities among the SWDIV design teams are evident in the RFP. Often the SWDIV team chooses to work through programming and conceptual design (0-20%) completed prior to advertising and selecting the DB contractor. Other RFP's included significant design, up to 80%. This was particularly true in BEQ projects that included a design package used on prior BEQ construction.

The accuracy of the research is dependent upon the accuracy of the data input into FIS. A large number (at least half) of the design contracts in particular seemed to have been built but not updated. In particular, the actual contract completion date was never updated from the legal contract completion date. This is true for the construction contracts but to a lesser degree. Interviews with the Contract Specialists and Contractor resulted in dates dissimilar to the dates recorded in FIS.

The comparison of this research includes an analysis of CG and TG of all MCON projects in the SWDIV database. The analysis is further defined to Vertical and Non Vertical projects. Then the projects are analyzed that were homogenous facility types

such as Family Fitness Centers, Child Care Centers and BEQ's. The specific analysis is focused on BEQ's for CG, TG, and quality performance.

D. PROJECT DATABASE CONSTRUCTION CONTRACT

1. Major Elements (DB and DBB)

The major elements used in the performance metrics for both project delivery types, DB and DBB was the award cost, the 1391 EE, the original contract completion date, and the actual contract completion date. The A/E award cost and original and actual contract completion dates was used for Design Construct-Placement.

2. Division Project Characteristics

a. Project Type

The study is focused on MCON projects only. The study focuses on all MCON projects completed in the defined time period. The projects are then further defined as vertical or non- vertical projects. The projects are then analyzed further as homogenous projects, such as Family Fitness Centers, Child Care Centers and BEQ's, both DB and DBB. The BEQ's are compared to all the MCON projects completed. Certain facility types behave differently than others in terms of cost and schedule [Ref. 8:p. 35]. The researcher expects to find that less complex facilities are typically less expensive in terms of unit cost and schedule overruns. For instance, high technology projects experience higher costs and schedule growth because of the highly complex environmental or processing systems and general intense production and project schedule goals. [Ref. 8:p. 35]

The facility characteristics such as the number of floors in the building, the construction type, size and specific building systems further describe the facility. A high number of floors or a multi-story building may require additional planning, for both horizontal and vertical sequencing and for the vertical transportation of personnel and materials. A single story building requires extensive horizontal sequencing and method planning due to large facility footprints and unconstrained construction sites. [Ref. 8:p. 36] Multi-story sequences may introduce additional confusion among trades and lost time due to poor coordination or construction method changes. Once patterns are established multi-story buildings can generally gain efficiencies of repetition not achieved on low rise or single story facilities. Poor information and communication may

lead to lost time, contract cost growth or undesirable levels of project quality. [Ref. 8:p. 36]

b. Project Dates

The projects date from FY1996 through FY2000. The first DB project was completed in FY1996. At the time of this research, numerous FY2001 projects were either not awarded or not completed, so FY2001 is not included in the study. To standardize cost data across fiscal years, indexing is necessary for a direct comparison of projects built during different years. The Building Cost Index History (1915-2001), published by the *Engineering News* Record, is used for Vertical projects. The Construction Cost Index History (1908-2001), published by the *Engineering News Record, i*s used for Horizontal projects. The base year was 2000. Adjusting FY1996-1999 dollars to FY2000 ensures the most current analysis between projects.

c. Project Financial Size

Project financial size varies depending on facility type. The study is focused on BEQ's. The BEQ's were similar but differed on number of buildings to be constructed.

d. Project Physical Size

Project physical size is specific to BEQ's. The SF unit cost is compared for all BEQ projects.

Comparisons are challenging in that performance differences on projects may result from the quality of the design documents, the performance period (rainy season, etc.), the contractor's personnel, the Government's personnel, experience, or location of work. It is beyond the scope of this research to address these variables.

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IV. ANALYSIS OF PROJECT DELIVERY METHODS

A. INTRODUCTION

This chapter graphically summarizes the results of the performance metrics, award growth, cost growth, and construction cost growth, design-construct placement and quality.

Using information extracted from the FIS database, this researcher was able to collect factual data to compare the specific performance metrics including award growth, cost growth, construction cost growth, and design-construct placement.

Personnel interviews and surveys were used to check the validity of the information extracted from the FIS database for the BEQ projects. Information extracted from FIS as well as personnel interviews and surveys were used to address the relative differences between projects delivered by DBB and DB.

B. ANALYSIS OF RELATIVE DIFFERENCES BETWEEN DB AND DBB

1. Award Growth

The entire database, including all MCON projects, DB and DBB, awarded and completed from FY1996- FY2000, was selected to determine the 1391 award growth. The NAVFAC Funding Requirement (FR) or 1391, which is the "CWE" provided to Congress and approved or in-acted was compared to the actual construction award amount. Figure 4.1 displays the award growth for all projects displayed as Vertical projects (building) and Horizontal projects (construction) for DB and DBB awarded from FY1996 – FY2000. Out of a total of 110 projects, 89 were classified as Vertical and 21 were classified as Horizontal. Of those Vertical projects, 32 were DB and 57 were DBB. The Horizontal projects included 4 DB and 17 DBB projects.

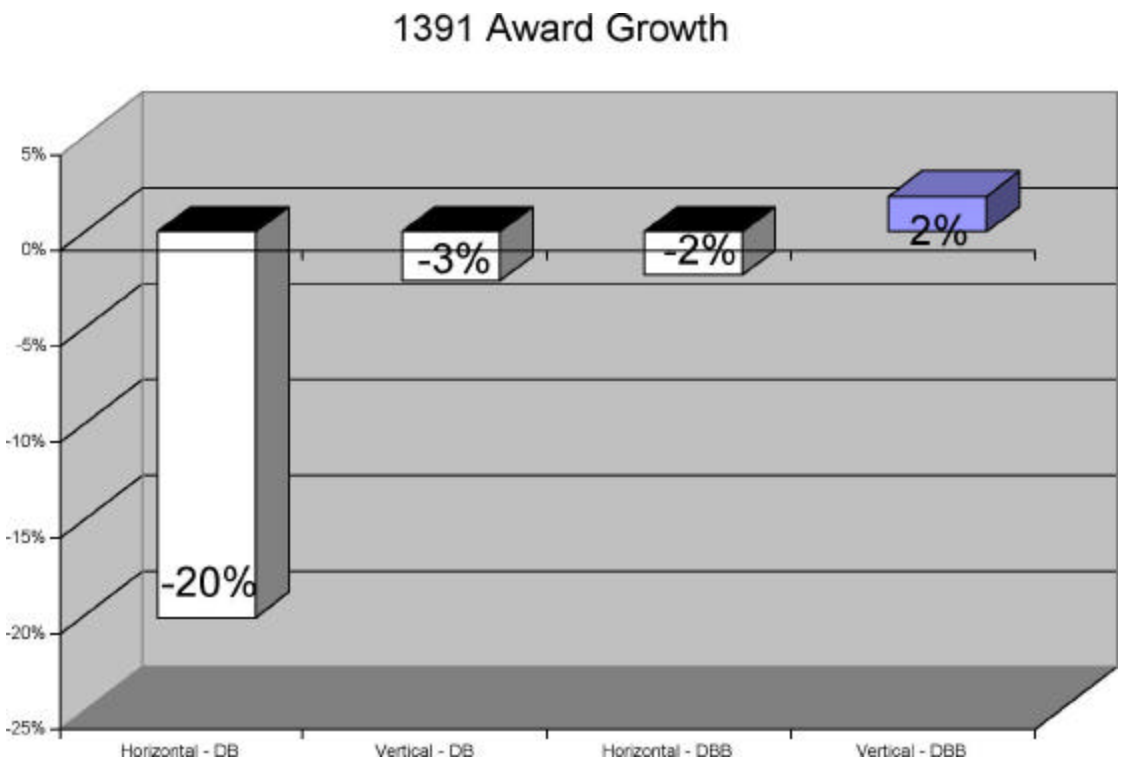

Figure 4.1. Award Growth Outcomes for Vertical and Horizontal DB Projects and Vertical and Horizontal DBB Projects. [Source: Developed by Researcher]

Figure 4.1 shows the award growth outcomes for vertical and horizontal DB projects and vertical and horizontal DBB projects. The ability to estimate accurate funding requirements ensures that resources are not tied up unnecessarily or conversely enough resources are allocated for the project. If SWDIV consistently overestimates its construction costs, it will be committing funding that might have been used for other projects. If SWDIV underestimates its construction costs, then project leaders may have to scramble to find project funds, escalate projects or worse case scenario request authority to reprogram.

Two projects that were reprogrammed were excluded from the calculation.

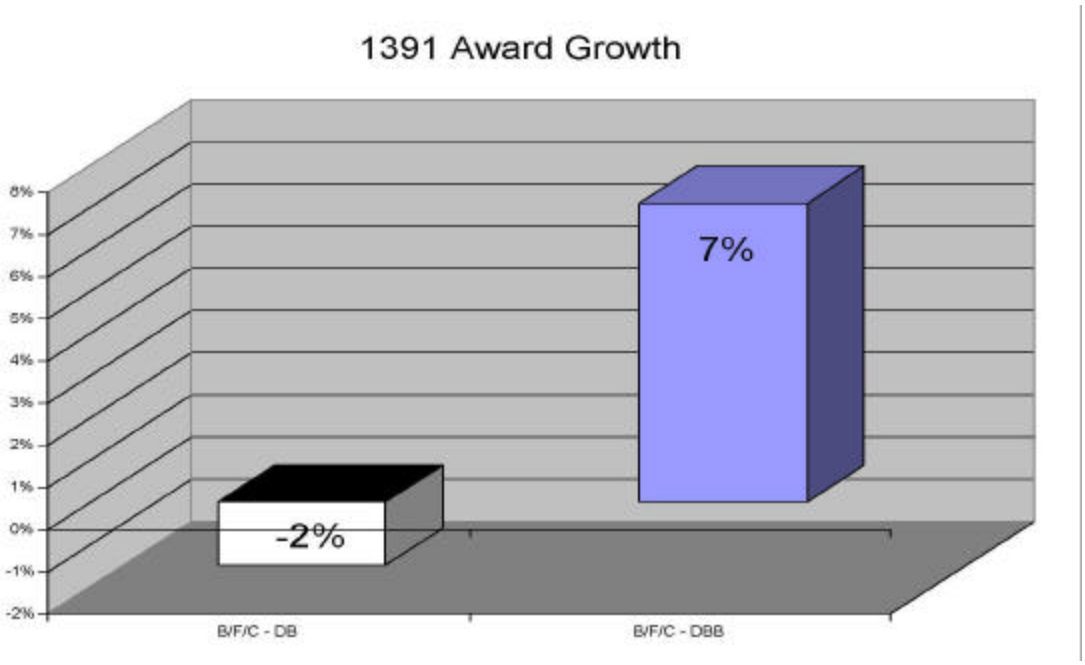

Figure 4.2. Award Growth for DB and DBB, BEQ's, Family Fitness Centers, and Child Care Centers. [Source: Developed by Researcher]

The award growth for DB and DBB, BEQ's, Family Fitness Centers, and Child Care Centers are shown in Figure 4.2. These projects are referred to as homogeneous, e.g. they are similar in kind and have a uniform structure or composition. These projects make up approximately 36% of the total project types and 31% of the total dollar value. The population includes 20 BEQ projects, 11 of which are DB, and 9 DBB. There are six Family Fitness Centers. Four are DB and two are DBB. There are seven Child Care Centers. Two are DB and five are DBB.

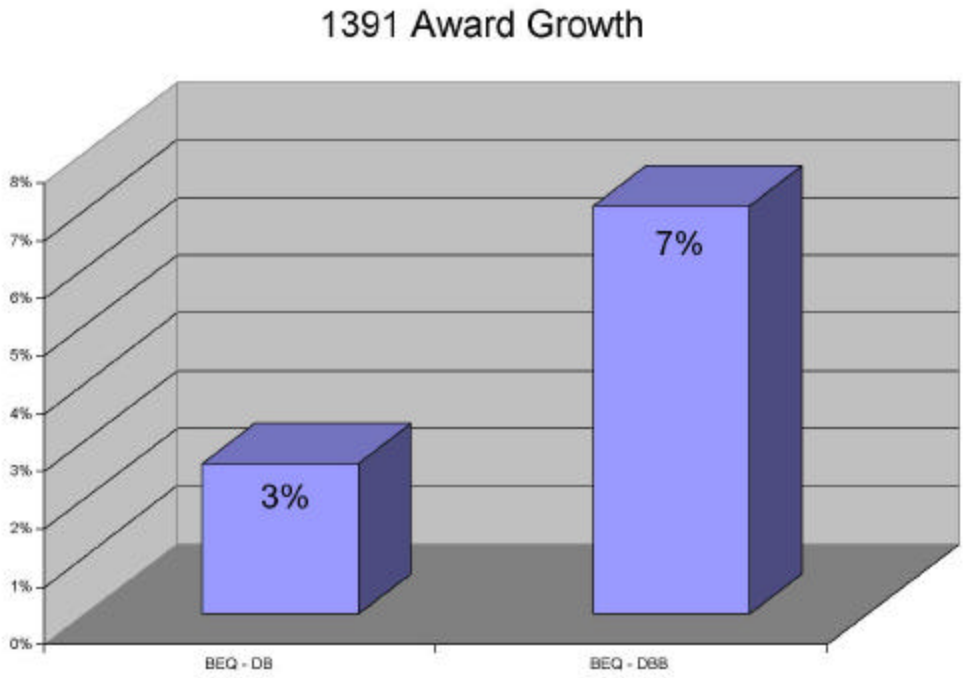

Figure 4.3. 1391 Award Growth for DB and DBB, BEQ Projects. [Source: Developed by Researcher]

Figure 4.3 represents the 1391 award growth for DB and DBB, BEQ projects. Bachelor enlisted quarter's represent 18% of the total number of projects and 25% of the total dollar volume.

2. Cost Growth

Figures 4.4, 4.5, and 4.6 represent cost growth. Figure 4.4 represents cost growth for all projects defined as DB or DBB, vertical building and horizontal construction. Figure 4.5 represents cost growth for homogeneous projects, DB and DBB. Figure 4.6 represents cost growth for DB and DBB, BEQ's.

Cost Growth includes the A/E contract for DBB projects. In this manner a like comparison is made. The design is inclusive in the DB project. However, a separate design contract is awarded in a DBB project. For cost growth the A/E contract was included with the construction contract in DBB projects to similarly compare cost growth to a DB project.

A high cost growth in a DBB project may indicate design errors and deficiencies. A high cost growth may also indicate unforeseen conditions.

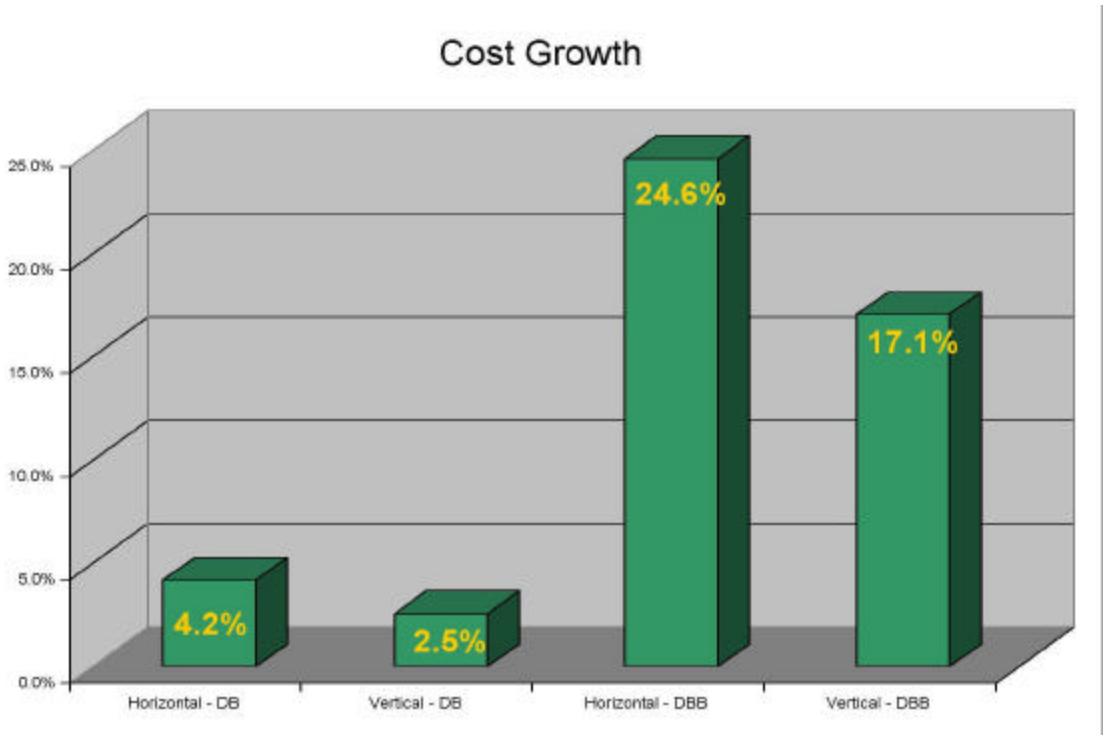

Figure 4.4. Cost Growth for all Projects Defined as DB or DBB, Vertical Building and Horizontal Construction. [Source: Developed by Researcher]

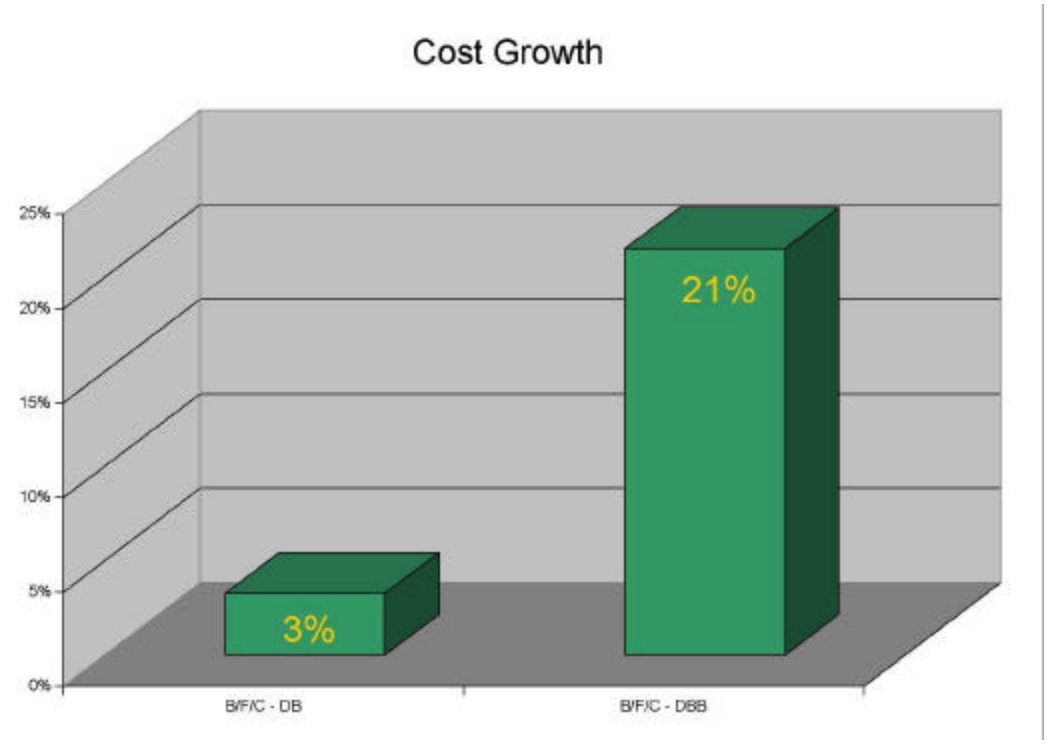

Figure 4.5. Cost Growth for Homogeneous Projects, DB and DBB. [Source: Developed by Researcher]

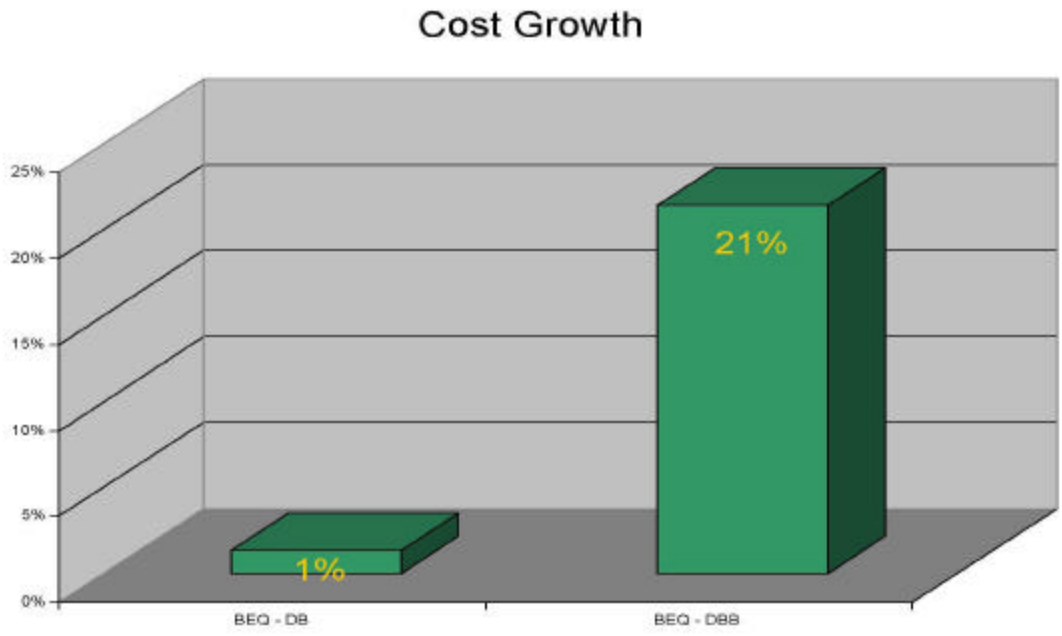

Figure 4.6. Cost Growth for DB and DBB, BEQ's. [Source: Developed by Researcher]

A high cost growth on BEQ, DBB projects might indicate a low bid, which results in change orders to the construction project.

Out of a total of 110 projects, 89 were classified as Vertical and 21 were classified as Horizontal. Of those Vertical projects, 32 were DB and 57 were DBB. The Horizontal projects included four DB and 17 DBB projects. The population includes 20 BEQ projects, 11 of which are DB, and 9 DBB. There are six Family Fitness Centers. Four are DB and two are DBB. There are seven Child Care Centers. Two are DB and five are DBB.

3. Construction Cost Growth

Construction Cost Growth depicts the cost growth on the construction contract for DB and DBB projects. It does not include the A/E contract. Figure 4.7 includes all DB and DBB vertical building projects and horizontal construction projects. Figure 4.8 shows the construction cost growth for homogeneous DB and DBB projects, e.g. BEQ's, family fitness centers and child care centers. Out of a total of 110 projects, 89 were classified as Vertical and 21 were classified as Horizontal. Of those Vertical projects 32 were DB and 57 were DBB. The Horizontal projects included 4 DB and 17 DBB

projects. The population includes 20 BEQ projects, 11 of which are DB, and 9 DBB. There are six Family Fitness Centers. Four are DB and two are DBB. There are seven Child Care Centers. Two are DB and five are DBB.

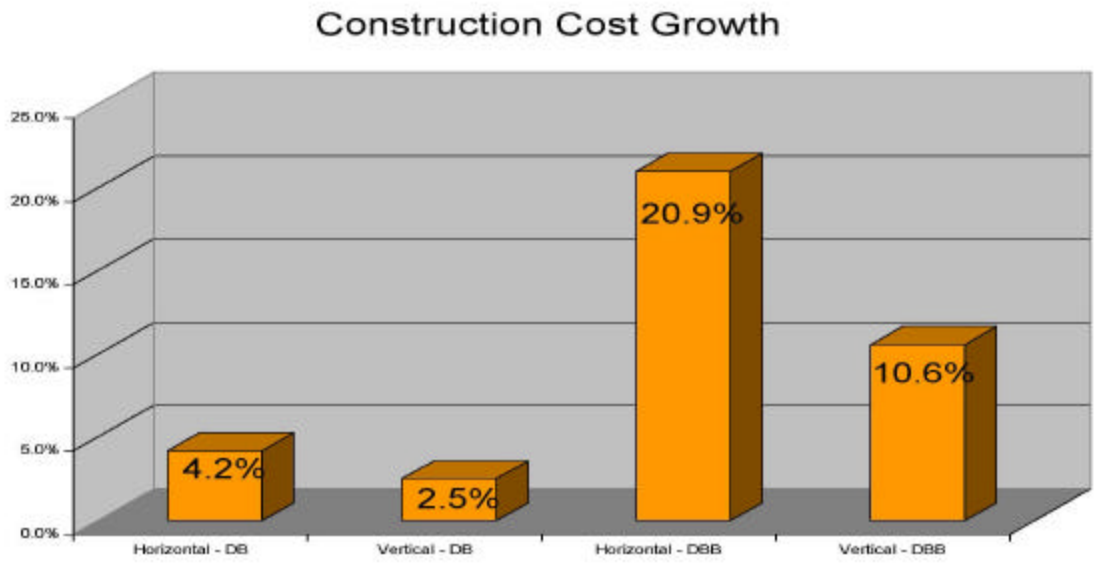

Figure 4.7. All DB and DBB Vertical Building Projects and Horizontal Construction Projects. [Source: Developed by Researcher]

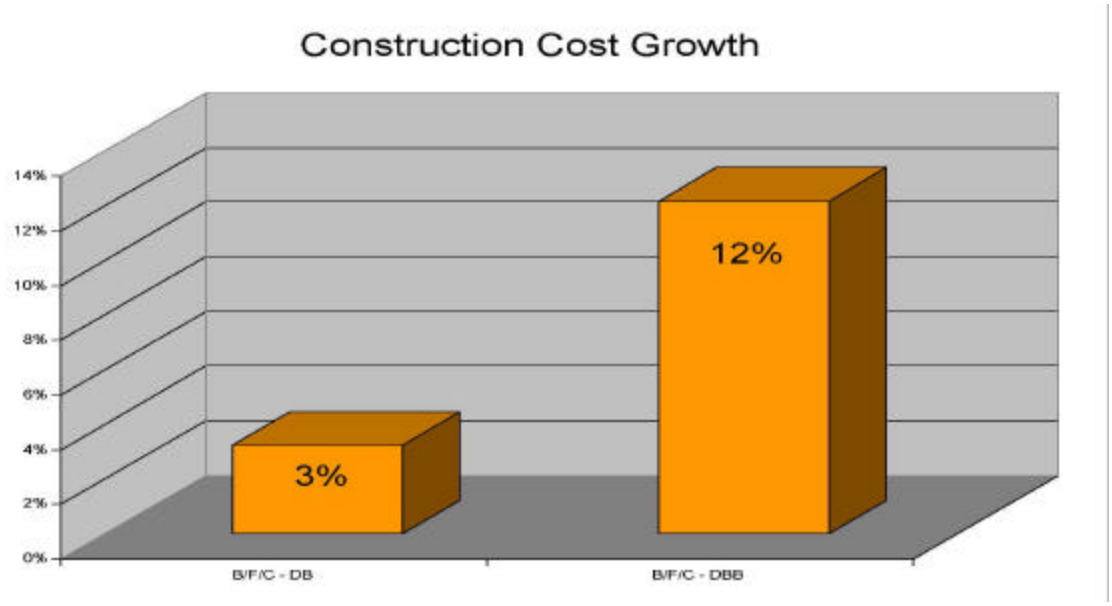

Figure 4.8. Construction Cost Growth for Homogeneous DB and DBB Projects, e.g. BEQ's, Family Fitness Centers and Child Care Centers. [Source: Developed by Researcher]

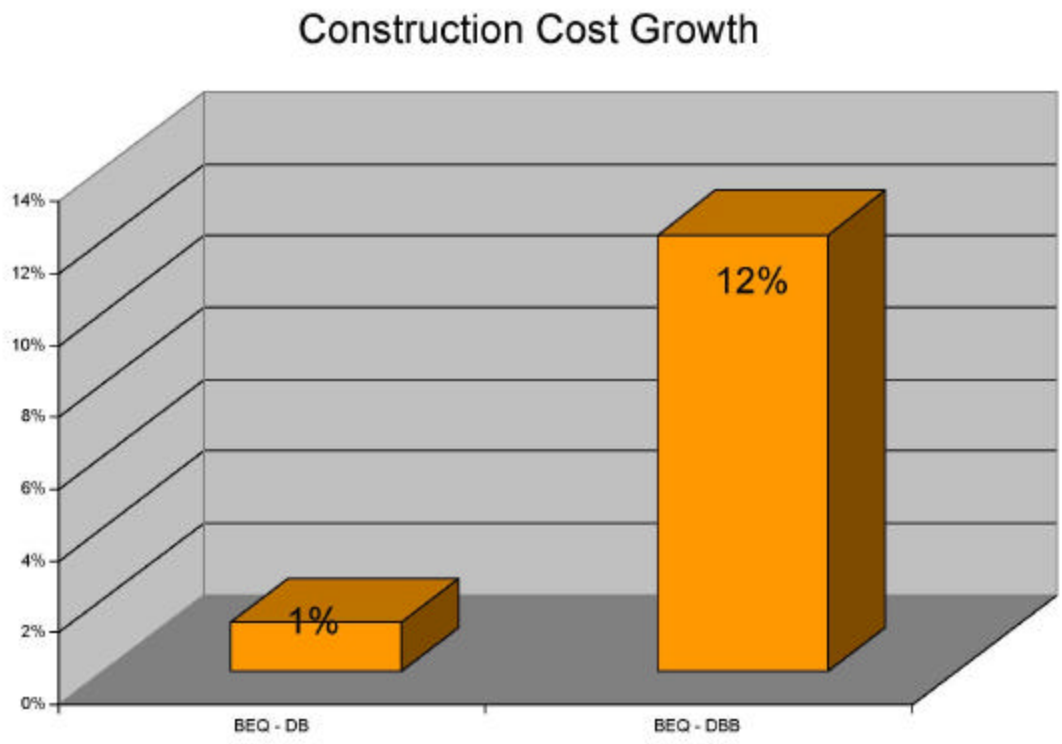

Figure 4.9. Construction Cost Growth for DB and DBB BEQ projects. [Source: Developed by Researcher]

The construction cost growth for DB and DBB BEQ projects are depicted above in Figure 4.9.

Interviews and data analysis give some clues for construction cost growth, which is discussed in more detail later in this chapter.

4. Time Growth

Time growth is shown in Figure 4.10 for all projects. Time growth includes the A/E contract. Time growth is shown for vertical building projects and horizontal construction for DB and DBB. Figure 4.11 shows time growth for homogeneous projects and Figure 4.12 displays time growth for DB and DBB BEQ projects. Out of a total of 110 projects, 89 were classified as Vertical and 21 were classified as Horizontal. Of those Vertical projects 32 were DB and 57 were DBB. The Horizontal projects included 4 DB and 17 DBB projects. The population includes 20 BEQ projects, 11 of which are

DB, and nine DBB. There are six Family Fitness Centers. Four are DB and two are DBB. There are seven Child Care Centers. Two are DB and five are DBB.

In a University of Florida study, of eleven completed DB Florida Department of Transportation (FDOT) projects and predicted time for DBB projects, all of the DB projects resulted in performing better than the expected DBB results. On average, the total DB project time was 35.7% less than predicted for performing the projects as traditional DBB. The DB construction time results were confirmed to be statistically greater than the DBB results at a 95% significance level. The lower bound of the 95% confidence interval is calculated to be at 18%. In other words, the statistical analysis indicate that at a 95% level of significance, the DB construction time results were at least 18% better than the average non-design/build results. Actual DB design procurement times were also considerably shorter than the normal design procurement time for non-DB design projects. The average DB design time was 54% less than the normal time allocated for non-DB design procurement. [Ref. 5:p. 38]

The Department of the Navy reports a 15 % savings in DB project cost and a 12% reduction in facility delivery time over DBB projects. [Ref. 7:p. 7]

The FDOT study resulted in a variety of causes for time growth. The most common reasons for after award contract changes was differing site conditions, owner requested changes, design errors and omissions and excusable delays.

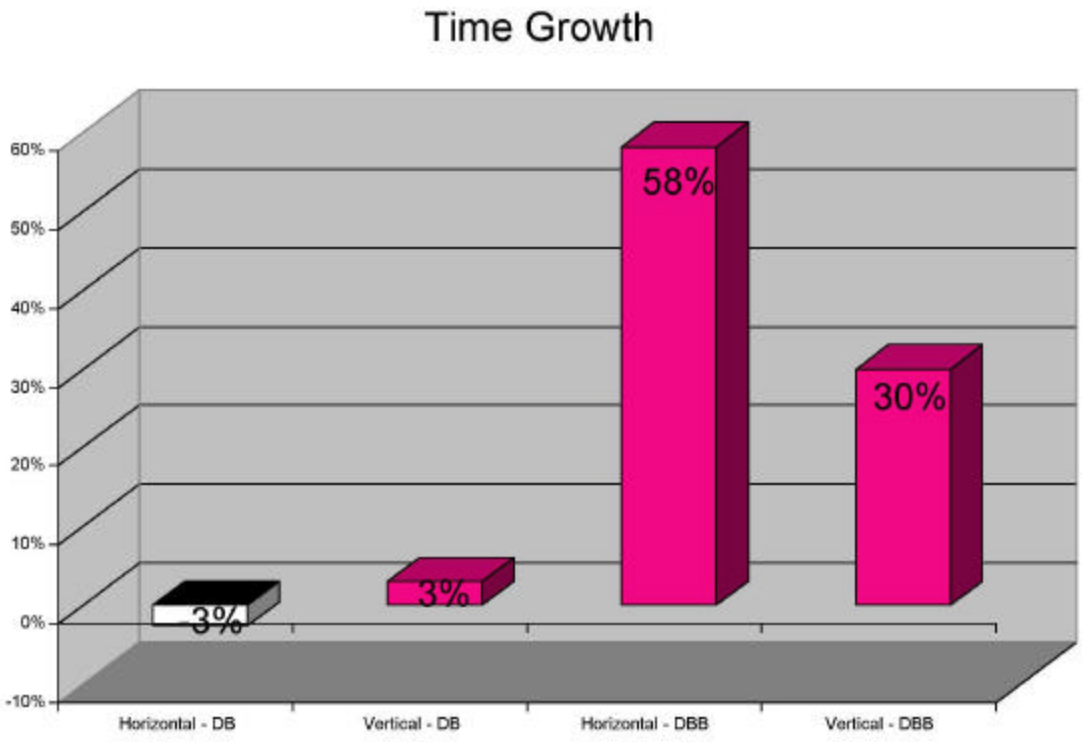

Figure 4.10. Time Growth for all Projects. [Source: Developed by Researcher]

Out of a total of 110 projects, 89 were classified as Vertical and 21 were classified as Horizontal. Of those Vertical projects, 32 were DB and 57 were DBB. The Horizontal projects included four DB and 17 DBB projects. The population includes 20 BEQ projects, 11 of which are DB, and nine DBB. There are six Family Fitness Centers. Four are DB and two are DBB. There are seven Child Care Centers. Two are DB and five are DBB. It can be seen in Figure 4.10 above that the project delivery system DB results in a lower percentage schedule growth.

In a Penn State study of 215 projects, which applied regression analysis for a schedule (time) growth model, when all variables were held constant, the effects of a delivery system indicated DB to be at least 11.37% less than DBB. [Ref. 9:p. 97]

In the Penn State model, eight key explanatory variables explained 24% of the variation in schedule or time growth. Four variables, which were statistically significant and accounted for the greatest proportion of the variation, in order of importance, were:

- Delivery System
- Excellent subcontractor experience with the facility
- Facility type
- As planned schedule duration

The study stated that the project delivery system and the subcontractors experience with the facility type was the leading variable in the model for schedule growth. In fact, the variables of DB held the most significance in the determination of schedule or time growth. The DBB projects resulted in significantly higher levels of schedule growth. [Ref .9:p. 98]

The Penn State study revealed four variables that accounted for a lower level of variation and therefore had a lesser impact on schedule growth performance. These variables include [Ref. 9:p. 99]:

- Procurement method
- Level of new construction
- Commercial terms
- The availability of a qualified pool of contractors

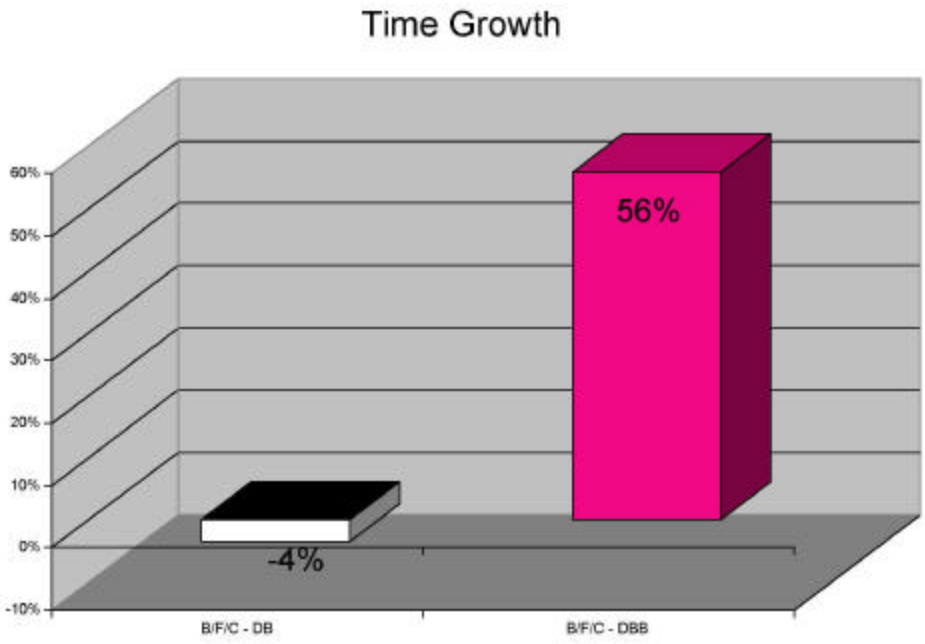

Figure 4.11. Time Growth for Homogeneous Projects. [Source: Developed by Researcher]

Time growth is generally coupled with cost growth, and this rule holds true when looking at the cost growth on the DB and DBB projects and similarly the time growth. The DB project system outperforms the DBB projects. [Ref. 7:p. 14]

A University of Colorado at Boulder report states that the possibility to reduce the overall project delivery time is one of DB's most significant promises. The Utah Department of Transportation is expecting to reduce their I-15 project delivery time from 8-10 years using the traditional delivery method to just 5 years with DB. They are two and one half years into the project, and are ahead of schedule and under budget. [Ref. 11:p.6]

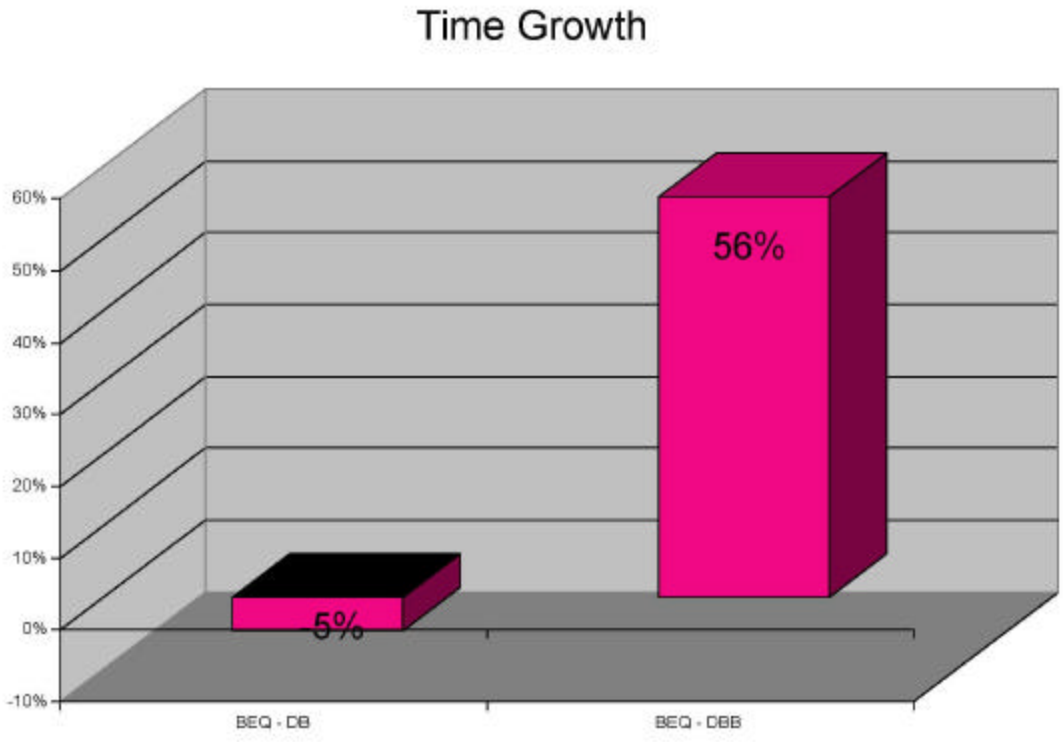

Figure 4.12. Time Growth for DB and DBB BEQ Projects. [Source: Developed by Researcher]

5. Design-Construct Placement

The design-construct placement includes the design contract and the final construction cost divided by the total time period between the start of the design contract

and the completion of the construction contract. "This gives the benefit of the doubt to a project delivery system that deliberately spends more time on design as a means of controlling construction cost growth". [Ref. 7:p. 10] This analysis is depicted in Figure 4.13 for all projects, DB and DBB vertical building projects and horizontal construction, and DB and DBB homogeneous projects. Figures 4.14 and 4.15 shows DB and DBB BEQs. Out of a total of 110 projects, 89 were classified as Vertical and 21 were classified as Horizontal. Of those Vertical projects 32 were DB and 57 were DBB. The Horizontal projects included 4 DB and 17 DBB projects. The population includes 20 BEQ projects, 11 of which are DB, and 9 DBB. There are six Family Fitness Centers. Four are DB and two are DBB. There are seven Child Care Centers. Two are DB and five are DBB.

In a research paper by Mr. Doug Gransberg, an analysis was done comparing Massachusetts DB and traditional projects to the DB and traditional projects in Indiana, Florida, and Texas. In the analysis, Massachusetts did not perform as well as the other states with resulting higher design and construction costs. "An efficient, well-managed project will have a high placement rate." A project with an error-free design and strong, positive relationship between the general contractor and subcontractors will be able to earn value at the maximum rate allowable by the physical constraints of the project.

> A project plagued by change orders and whose business relationships are defined legalistically will have three project performance indicators: high cost growth, high time growth, and low construction placement. [Ref. 7:p. 15]

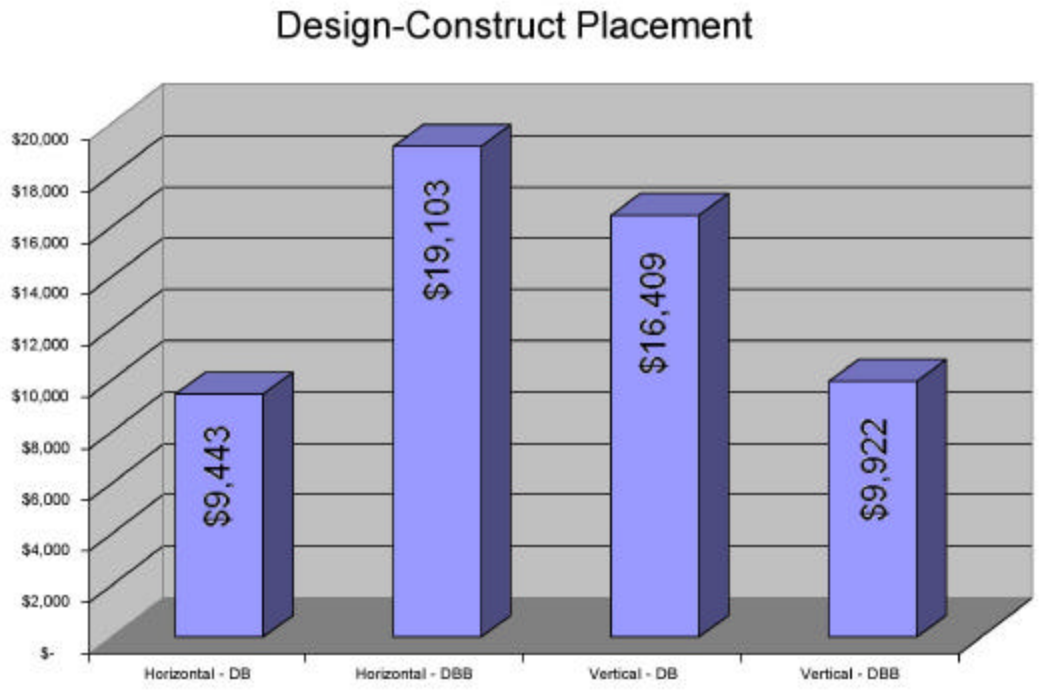

Figure 4.13. Design-Construct Placement Analysis for all Projects, DB and DBB Vertical Building Projects and Horizontal Construction, and DB and DBB Homogeneous Projects. [Source: Developed by Researcher]

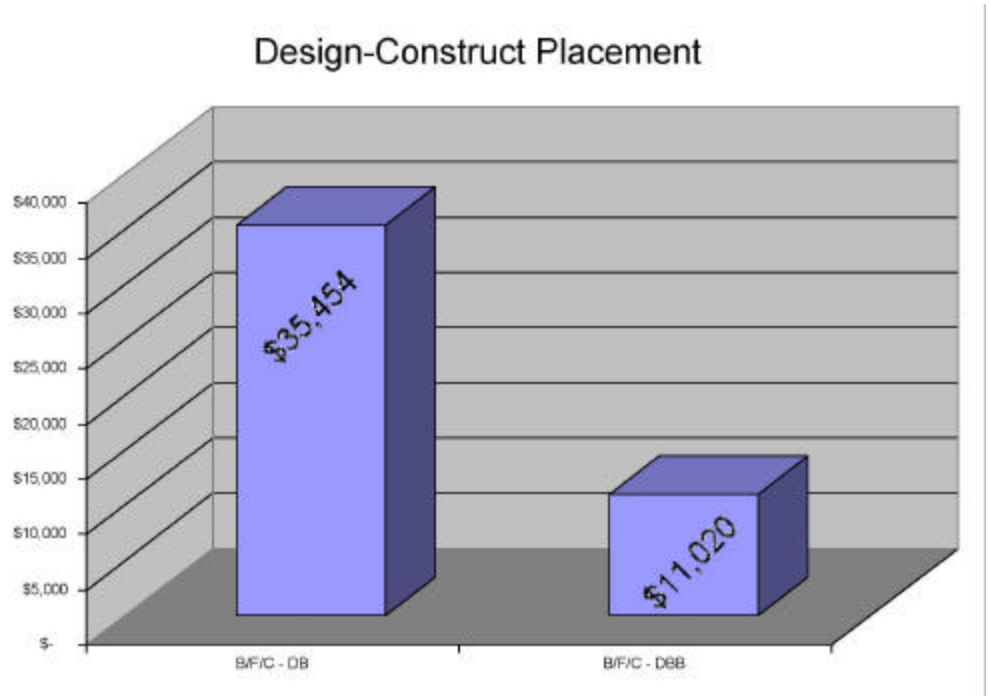

Figure 4.14. Design-Construct Placement Analysis for B/F/C-DB and B/F/C-DBB Projects. [Source: Developed by Researcher]

Mr. Greg Ricker of Harper Construction Company, Inc. stated that if the Government truly trusted the selected DB contractor, the contractor would be designing and building as they went along, thus realizing a higher design-construct placement. He recommended that the Notices to Proceed (NTP) should be issued immediately. [Ref. 13]

The number of design days built in the contract varies from contract to contract. In the Harper Construction contract, the number of days built in for design was 159 days. In a C. E. Wylie Construction contract, the number of design days built in the contract was 148. In another BEQ DB construction contract, the design cycle was 204 days. In still another DB construction contract, the design cycle was six weeks.

Mr. Ed Wylie, owner of C. E. Wylie Construction, states to improve the design-construct placement rate, the sixty percent (60%) design submission and the over the shoulder review should be eliminated. He also noted that the NTP for site work should be issued immediately. [Ref. 20]

Mr. David Golden of Harper Construction Company, Inc. stated that the contractor does not have time to refine their design based on the arbitrary schedule built in the contract. The design is a work in progress. The Government should not stipulate a schedule. "If they trusted the contractor they wouldn't have to". [Ref. 13]

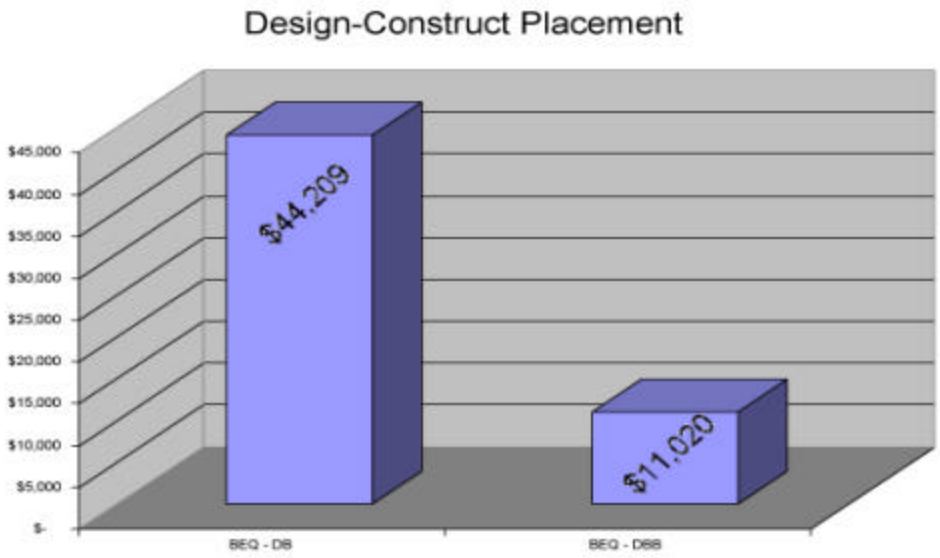

Figure 4.15. Design-Construct Placement Analysis for BEQ-DB and BEQ-DBB Projects. [Source: Developed by Researcher]

6. Square Foot Cost for DB and DBB (BEQ)

The Government estimate square foot cost mean, mode and median costs for BEQ DB and DBB is displayed below in Figure 4.16. The projects are all BEQ's and displayed as a combined total of DB or DBB square foot costs.

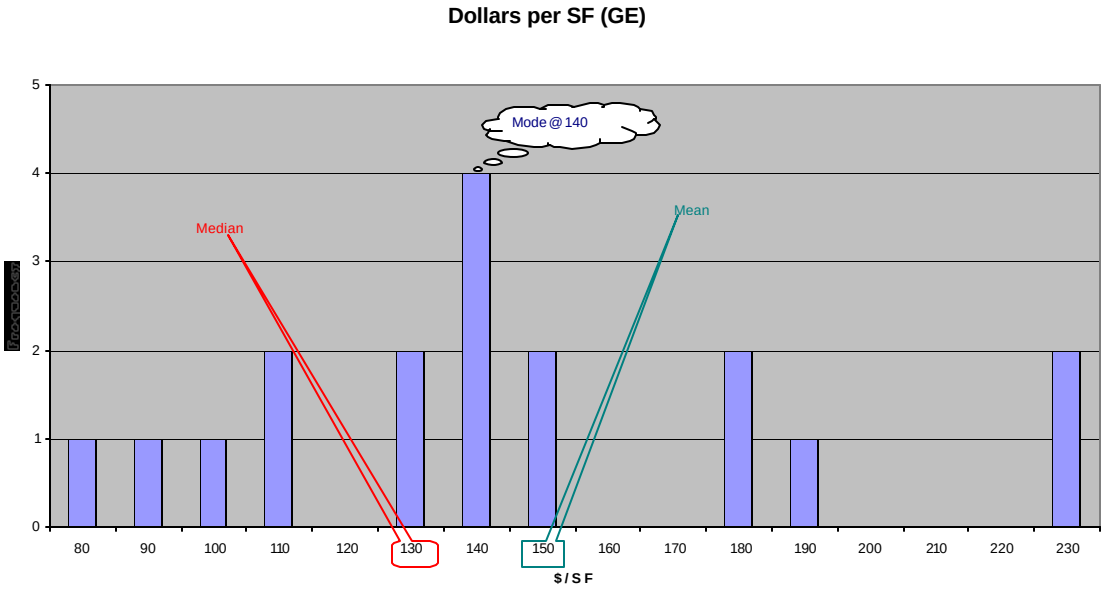

Figure 4.16. Government Estimate Square Foot Cost Mean, Mode and Median Costs for BEQ DB and DBB. [Source: Developed by Researcher]

The square foot cost mean, mode and median costs for BEQ DB and DBB for the final contract price is displayed below in Figure 4.17. All BEQ s awarded and completed from FY1996-2000 were included in the data. The median for all projects was $130.00, the modal square foot was $140.00 and the mean was $150.00. The data was sorted in increments of $10.00. The mean average is the dollar amount lying halfway between the highest square foot average and the lowest square foot average. The median average is the average square foot located exactly in the middle. The mode is determined by listing each square foot average and then noting the number of projects that fall within that average.

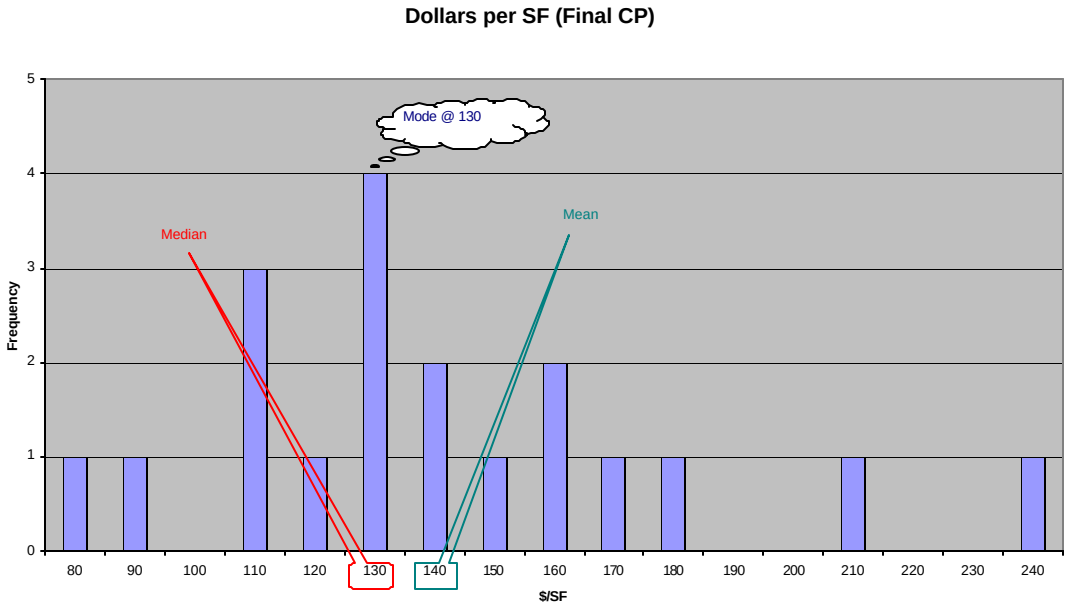

Figure 4.17. Square Foot Cost Mean, Mode and Median Costs for BEQ DB and DBB for the Final Contract Price. [Source: Developed by Researcher]

The mean, mode and median for the average square foot price based on the awarded contract price are displayed in Figure 4.17. The mean is $140.00, the modal and median is $130.00.

The average SF cost for DBB is $134.41 and the average SF cost for DB is $117.23. The Mean Absolute Deviation or MAD for the GE square foot and Final Contract Price (CP) is as follows:

GE MAD	DB=40	DBB=17.14
CP MAD	DB=35	DBB=18.57

The Standard Deviation for the GE square foot and CP is as follows:

GE Standard Deviation	DB=48.13	DBB=23.30
CP Standard Deviation	DB=156.84	DBB=57.45

It can be seen by the statistics above that the DB square foot cost averages are more variable for the DB projects. Whether this is because DB is a fairly new project delivery method or whether the Government and Contractor are unsure of the risk may be a reason for the variation in pricing.

A t-test revealed while there is a difference in the mean averages between DB and DBB, there is no statistically significant difference between the two sets of data, because the P value is above 0.05. In other words, the difference in means is not great enough and could just have happened due to the small number of observations.

In the Penn State study, when all other variables were held constant, the effects of the delivery system indicated the unit cost or square foot cost of DB projects to be at least 6.1% less than DBB. [Ref. 9:p. 86]

7. Quality Differences/Customer Satisfaction

Quality performance was measured in seven specific areas for BEQ projects. [Ref. 9:p. 79]. Mean scores are reported as depicted in Figures 4.18 and 4.19 below. The highest level of quality that can be achieved is a score of 10. Quality was recorded separately for the turnover process and for the performance of specific systems. [Ref. 9:p. 79]

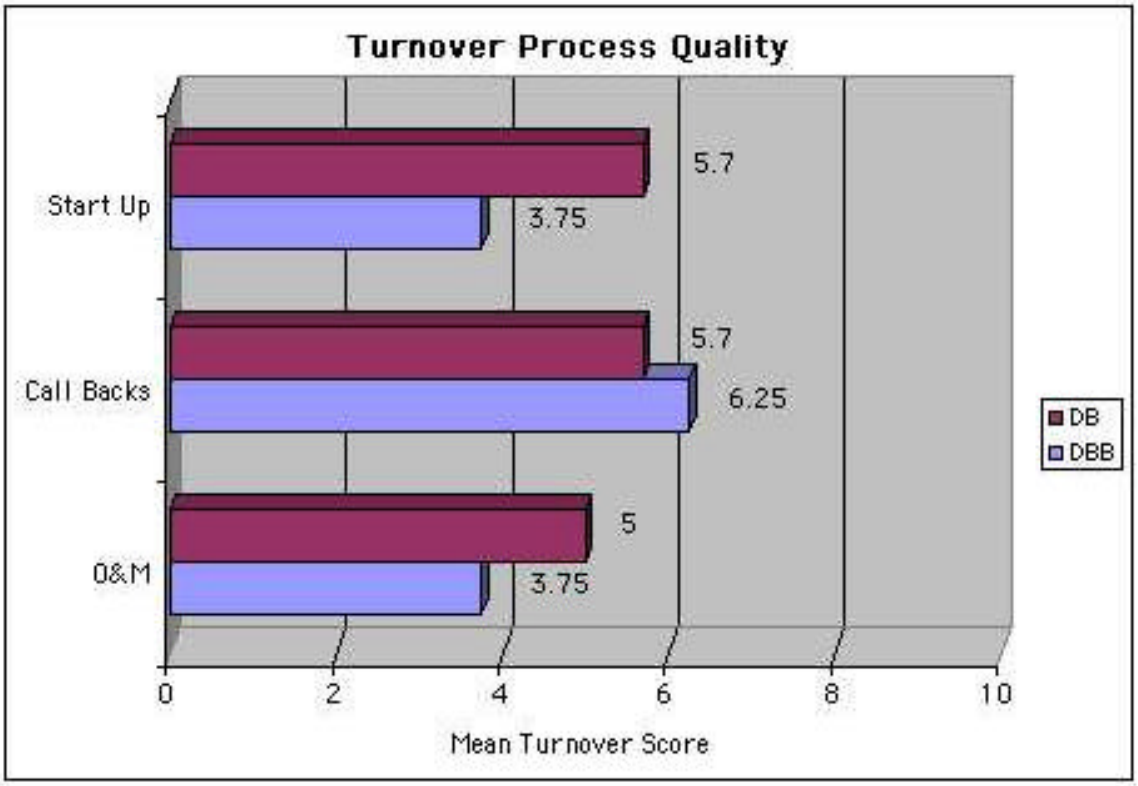

Figure 4. 18. Mean Scores of Quality Performance Measured in Seven Specific Areas for BEQ Projects. [Source: Developed by Researcher]

The turnover process depicts a score of 10 as showing little difficulty in starting up the facility, little number of call backs for repair, and little difficulty in operating and maintaining the facility. Conversely, a low score represents a high degree of difficulty. DB projects experienced less difficulty in start up and operations and maintenance. DBB projects had fewer call- backs then DB.

Figure 4.19. Mean Scores of Quality Performance Measured in Seven Specific Areas for BEQ Projects. [Source: Developed by Researcher]

Figure 4.19 above presents system performance quality. A high score of 10 indicates that the listed system had exceeded the quality expectation of the client. A score of five represents that the owner's expectations were met. The worse case scenario would be a score of zero, which represents the owner's expectations were not met.

With the exception of envelope, roof, structure, and foundations, the DBB project delivery method resulted in a higher owner's satisfaction.

In an attempt to find out why DB resulted in no higher than meeting the customer's expectations, this researcher interviewed Mr. Steve Wolfe, deputy Public works officer at Camp Pendleton, MCAS, MCB. More than half of the BEQ's built between 1996-2000 were built for the Marine Corps. Almost half were built on Camp Pendleton. Mr. Wolfe stated that the Marines dictate exactly what they want in a BEQ. They basically tell the contractor in the RFP what the room size, floor plan, roof plan, and site plan will be. Mr. Wolfe stated that the Marines want control. The contractor basically designs the mechanical and electrical drawings. [Ref. 19]

Mr. Ed Wylie, owner of C.E. Wylie Construction, stated that with BEQ's "we don't really need an architect for design but a draftsman to fill in the gaps". Mr. Wylie was responding to a BEQ RFP that included several hundred pages of prescriptive specifications and full-page drawings. The full-page drawings included a site survey, demolition plan, grading plan, utility plan, horizontal control plan, first floor plan, second floor and partial roof plan, third floor and partial roof plan, fourth floor and partial roof plan. It included elevations for all the living units, reflective ceiling plan, framing plan, west, north, south and east elevations, 3-story building cross sections including stairs and building ends, 2-story building cross sections including stairs and building end section. Also, electrical site demolition plan and electrical site plan, electrical living modules for interior CARV riser, interior telephone, and elevation detail. The drawings also included the room finish schedule. [Ref. 20]

A Marine occupant was interviewed who said he expected what they got. He understood that the room size was fixed and that he could expect no more or no less.

In an interview with Mr. David Golden, Vice President of Preconstruction for Harper Construction Company, Inc., he stated that he could see control issues in the RFP. He stated that setting limitations hurts the Government. The contractor is not allowed to be imaginative or creative. [Ref .13]

The following is a list of survey responses to the question: What are the Best things about this facility? The project delivery type is listed in parenthesis after the comment, e.g. DB or DBB.

- Attractive, nice living quarters for Marines (DBB)
- Self-contained; activity center, phone booths, laundry and basketball courts (DBB)
- Pipe chaser makes it easier to get to and fix problems. (DBB)
- Overall appearance very good (DB)
- The contractor left a worker behind for 3 months to work warranty issues (DB)
- Building works well and includes an interior privacy court yard, also the colors look good (DB)
- The ROICC did an outstanding job working with the base architect and contractor (DB)
- Customer was involved from the beginning (DB)
- Nice landscape (DBB)
- Few changes and more flexibility, partnered project (DB)
- Early start on construction allowed contractor to finish one month early (DB)
- ROICC was involved from the beginning (DB)
- ROICC involved in selection process which gave us a jumpstart upon award (DB)
- Great cooperation between the Government and contractor because of partnering (DBB)

The following is a list of survey responses to the question: What are the worst things about this facility? The project delivery type is listed in parenthesis after the comment, e.g. DB or DBB.

- No office space for companies that occupy it (DBB)
- Fire sprinkler system not maintained. Alarms are not connected to fire department (DBB)
- Sprinkler system, for landscape, that was installed by the contractor is not maintained by the base (DBB)
- Many warranty items (towel racks, soap dishes, etc.) broke immediately after the end of the warranty period (12 months) (DBB)
- Not enough phones to fill the phone booths because of a line shortage (DBB)
- Need more liaison between SWDIV and Facility Maintenance Department (FMO) so everyone knows what FMO is and can be responsible for fixing.

A better liaison with the public works department (PWD) to ensure all issues are addressed and taken care of (phone booths for one). (DBB)

- Need better quality materials (DBB)
- Need office space (DBB)
- Too much building in too small of an area (DB)
- Not a lot of quality subcontractors in Yuma (DB)
- Government team not experienced with DB (DB)
- Standard, plain design (DBB)
- Many small design changes causing a lot of administrative effort. (DBB)
- Little flexibility (DBB)
- ROICC wasn't involved in pre-award process or administration during design (DB)
- Very detailed and prescriptive RFP, which limited creativity (DB)
- Walls hard to clean, paint comes off (DBB)
- Some of the air ducts drip (DBB)
- Thermostats should be in both rooms. When the Marine with the thermostat is in the field or on leave, the other room has no temperature controls (DBB)
- Water pressure and material quality is bad (DBB)
- Not enough parking (DBB)
- Storm drainage system not sufficient (DBB)
- Post award team members should be more involved/aware during design and pre-award phase of contract (DBB)

The Penn State study, after which this quality survey was modeled, showed that DB projects achieved equal if not better quality results than other projects studied. The DB projects offered significantly better quality results than DBB in all categories except that of interior space and layout. The total mean score for DB in the seven quality areas was 45.82 compared to DBB at 39.95 in the Penn State study. [Ref. 8:p. 439]

8. Change Order Impact and Rate

It is beyond the scope of this research to analyze the change order rate and impact for each BEQ project. This researcher did analyze the BEQ projects with some of the highest change order rate to get a sense of what type of changes occurred. In one DBB project, (experiencing the highest change order rate of 85.1%), the modifications were

recorded as followed: 65% of the changes were recorded as criteria changes, 34% were unforeseen changes and 1% was customer requested changes. Another DBB with a 12% cost growth recorded 77% of the changes as due to criteria change, 13% due to unforeseen, and 10% as a result of customer requested changes. On a DBB with a 6% cost growth, the changes were recorded as 67% due to design, 28% to customer requests, and 3% to unforeseen. On another DBB project, which experienced a 1.9% cost growth, all the changes were contributed to design errors.

DB cost growth was 1%. In an interview with Mr. Ed Wylie, owner of C.E. Wylie construction, he said that the entire cost growth on a DB BEQ project awarded to them was due to the Government changing their minds about required scope after award of the project. The project experienced .0096 percent growth. The Government supplied the contractor topography surveys that were incorrect. The elevations were wrong and the changes resulted in a change to the contract. The Government had originally told the contractor that telephone poles would be removed by Government forces but later modified the contract to have the contractor remove the telephone poles. The Government also made several design changes after award of the contract that resulted in a credit modification. [Ref. 20]

A study of 209 Department of Defense projects show DB projects have 33 percent fewer changes due to design deficiencies than projects procured in the traditional method. These savings are significant because they are for vertical projects. [Ref. 7:p. 7] "Vertical projects have a higher potential for savings through the use of innovative procurement practices than horizontal projects because there is much more room for technological innovation and creative design." [Ref. 7:p. 7]

The FDOT study reported that DB projects result in an average change amount of –1.99%. The FDOT's non DB projects for 1990 had an average change amount of 8.78%. [Ref. 5:p. 39] These projects were all horizontal projects.

Changes to the contract often result because the Government provides too much design documentation. The DB method should absolve the owner for design risk up to the point that it falls short of defining its requirements and design criteria for the design builder. The importance of the amount of design in the RFP is highlighted in a recent

article in *Contract Management*, which states that owners who develop the design to 35% complete inadvertently assume the liability of cost overrun from changes to the original design furnished by the owner in the bid documents. [Ref. 2:p. 8]

Owners can unknowingly expose themselves to the *Spearin* doctrine liability if the owner makes significant changes so that the DB firm can no longer build the project according to the quoted price. [Ref. 8:pp. 21-22]

9. Liquidated Damages Days and Total Amount Assessed

No liquidated damages were assessed for BEQ DB projects. DBB BEQ projects resulted in one project with 300 days of liquidated damages assessed. The project was ultimately terminated for default. This project had a 78.3% schedule growth and 7.7% cost growth. The surety completed the project.

C. CHAPTER SUMMARY

This chapter was a quantitative analysis of the DB and DBB project delivery methods. The analysis included all projects for MCON, awarded and completed, from FY1996-2000. The data was normalized using the Engineering News Record (ENR) indices for construction, for horizontal projects, and building, for vertical projects. The projects were looked at in FY2000 dollars.

The analysis includes the relative differences for cost, schedule and quality for DB and DBB projects. The study focused on BEQ's. The survey (BEQ) quality comments were taken from owners, contractors, A/E's, maintainers of the facility, project engineers, occupants and contract specialists.

In summary, the analysis shows DB to provide a delivery system that meets budget and schedule mandates, and in some areas provide better quality.

The Army echoes this conclusion. In an article, Design-Build in the Corps of Engineers, in *The Military Engineer*, January-February 2001 edition, states that the Corps of Engineers is using DB more as it transitions away from the traditional DBB method. With the fiscal year 2002 construction program, the Army's Office of the Assistant Chief of Staff or Installation (OAC-SIM) and the Corps' Office of Military Programs have jointly committed to executing 25% of the stateside Military Construction (MCA)

program using DB. The Army, in subsequent years, plans to increase the use of DB stateside to 50%. [Ref. 4:p. 21]

A significant share of the Army MCA program for the next few years (approximately $6 billion dollars) will consist of barrack complexes. The greatest single driver for using DB for this construction is that, according to OAC-SIM, with declining planning and design appropriations, there is a compelling mandate to "build to budget". The DB project delivery method is seen as a cost saver or rather as a non-budget buster. [Ref. 4:p. 21]

In an article, Selecting Design-Build; Private and Public Sector Owner Attitudes, in the *ASCE Journal of Engineering Management*, November 1996 issue, the authors researched why owners choose DB as a project delivery method. Based on a response that consisted of 63% owners from the public sector and 37% from the private sector, the research revealed that the primary reason owners select DB is to shorten duration of the project. The research concluded that the primary reason owners select DB is to take advantage of the time savings inherent in the process. The research also concluded that contrary to the inherent difference in private and public procurement procedures, DB selection attitudes could generally be treated as equivalent. [Ref. 14:pp. 47-53]

Testimony that DB is the vehicle chosen when projects need to be fast tracked is the recent contract award announcement on September 15, 2001 by the United States Department of Defense, which reports a DB contract award to Hensel Phelps Construction Co., to rebuild the damaged Pentagon after the terrorist attack on September 11, 2001. Mr. Lee Evey, the Pentagon renovation program manager, stated that with a DB contract the renovation repairs could begin immediately. He stated, "The design-build approach has already demonstrated that it can succeed within this environment." [Ref. 12]

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V. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

This thesis used actual data from the SWDIV FIS database to analyze the cost growth, and schedule growth of all MCON projects awarded from FY1996-2000. Since the data was accessible, the award growth from the congressional enacted DD1391 was analyzed for all MCON project. The design-construct placement analysis was performed by extracting data on the A/E and associated DBB construction contract. Also, the A/E data was used in the cost growth comparison to ensure a like comparison was made. The project costs were also looked at just from the construction contract cost growth. The comparison then looked at homogenous MCON projects and finally at BEQ's delivered by DB or DBB. A survey questionnaire was used in an effort to answer questions about the facilities system performance and turnover process quality for BEQ's.

In this chapter, the researcher presents conclusions derived from this research as well as recommendations for enhancing the DB project delivery system.

B. CONCLUSIONS

Analysis of the data extracted from FIS and survey questionnaires reveals the following conclusions with regards to DB and DBB project delivery system performance.

Conclusion 1: The award growth from the NAVFAC FR, DD1391 resulted in a negative growth of -20% for all horizontal DB projects. Vertical DB and Horizontal DBB also resulted in a negative growth of -3% and –2% respectively. Vertical DBB award growth was 3%. When looked at by homogenous projects, family fitness centers, child care centers and BEQ's combined, the award growth for DB was a negative -2% and a positive 7% for DBB. Award growth for DB BEQ's was a positive 3% and a positive 7% for DBB. Overall, SWDIV's estimates for DB projects appear to be inaccurate which may tie up resources unnecessarily. Conversely, for the positive growth, resources are underestimated for Vertical DBB projects, including family fitness centers, day care centers and BEQ's. This may result in project managers scrambling to find funds for their projects.

Conclusion 2: Cost growth is higher for all DBB projects. Cost growth for all horizontal and vertical DBB projects is 24.6% and 17.1% respectively. Family Fitness Centers, Day Care Centers and BEQ's, when delivered by DBB, results in a 21% cost growth. For BEQ's, the cost growth in a DBB project is 21%. The DB project delivery system results in lower cost growth in all areas. The horizontal and vertical projects show 4.2% and 2.5% growth respectively. The family fitness center, day care centers and BEQ's results in a 3% cost growth. The BEQ projects result in a 1% cost growth.

Conclusion 3: For Construction Cost Growth, the growth on the construction contract only, the DBB method results in higher cost growth in horizontal and vertical projects. The DBB method is a higher construction cost system for family fitness centers, day care centers and BEQs. The horizontal cost growth is 20.9%, the vertical is 10.6%, for family fitness centers, day care centers and BEQ's, the construction cost growth is 12%, and for BEQ's alone, the cost growth is 12%. The horizontal and vertical construction cost growth for DB is 4.2% and 2.5% respectively, and 3% for family fitness centers, day care centers and BEQ's. The construction cost growth is 1% for BEQ's.

Conclusion 4: The DB project delivery system results in lower time growth or schedule growth then the traditional DBB method. For vertical and horizontal DBB projects, the time growth was 58% and 30% respectively. The DB time growth for vertical and horizontal projects was 3% and –3% respectively. For the homogenous projects, DBB results in a 56% time growth compared to DB at a –4% time growth. For the BEQ DBB projects, the time growth is 56% compared to 5% for DB BEQ projects.

Conclusion 5: The DB project delivery method results in a higher design-construct placement except for all horizontal projects in which DBB performed higher. It should be noted that there were only four (4) horizontal projects completed by DB for the time frame FY1996-2000. This is in comparison to the seventeen, (17) DBB projects completed during the same time frame. The DCP for horizontal and vertical DBB projects is $19,103 and $9,922 respectively. The DB DCP for horizontal and vertical projects is $9,443 and $16,409 respectively. The homogenous DBB projects DCP is $11,020 compared to DB at $35,454. For the BEQ projects the DBB DCP is $11,020 compared to DB DCP at $44,209.

Conclusion 6: The DB square foot (SF) costs are more variable then the DBB SF costs. The mean, mode and median from the GE and the final CP results in a mean absolute deviation (MAD) for the GE of 40 compared to the DBB at 17.14. The CP MAD for DB is 35 and the DBB MAD is 18.57. The Standard Deviation (SD) for the DB GE is 48.13 and 23.30 for DBB. The SD for the CP SD is 156.84 for DB compared to 57.45 for DBB. The average SF cost for DB is $117.23 and $134.41 for DBB.

Conclusion 7: The survey questionnaire showed that DB outperformed DBB in two out of three areas of turnover process quality. The DBB method resulted in better performance in the areas of starting up the facility and operations and maintenance. The DBB method resulted in better quality for the number of call- backs

Conclusion 8: The survey questionnaire for system performance quality results in DBB outperforming DB in three out of four categories. The DBB method resulted in better quality in the areas of interior space and layout, environment, and process equipment and layout. The DB method scored higher in envelope, roof, structure and foundations.

Conclusion 9: Despite the higher scores in system performance quality for the DBB methods, actual remarks testified to poor quality materials and warranty problems. Several remarks by those surveyed call for more involvement from the beginning for team members on the post award side for both DB and DBB projects.

C. RECOMMENDATIONS

Recommendation 1: The DB project delivery method outperforms DBB in terms of cost growth and time growth. This project delivery tool has proved to deliver a project on time and within budget. A project delivery system that combines the construction and design function within a single entity enhances project efficiency. The DB method should be used if the project is a viable candidate. The policy and guidance for the application and execution of DB as a project delivery method as promulgated in the NAVFACENGCOM HEADQUARTERS policy memorandum EXECUTION OF DESIGN-BUILD CONSTRUCTION, dated August 7, 2000 should be followed. Also, when deliberating whether to use DB, the guidance on the SWDIV Intranet web site is extremely beneficial and should be used. A DB electronic manual, which outlines a 10-

step process to DB, is available on the SDIV website as well. [Ref. 16] Another valuable aid is on the University of Colorado website [Ref. 10]. This is a DB Selector Predictive tool. The tool is a predictive and advisory system, which produces an overall rating for the appropriateness of projects for DB. An important function in this tool is that it takes you through a clear and concise decision matrix. For example, the first part of the interface (there are four (4) parts) is a project characteristic questionnaire. Important questions on the level of design complete, RFP, and schedule are contained in this part. The second part lists success criteria questions, the third part list project and personal data questions and finally the fourth part provides a graphical output and advisory. This researcher recommends that a similar predictive tool be implemented at SWDIV.

Recommendation 2: The DB process should ensure that the RFP is standardized. Several prime contractors commented on the different RFP formats. The solicitation packages included varying design cycles, design complete and varying performance and prescriptive specifications. Also, evaluation criteria for the "nice to have" items were not prioritized leaving the contractor to guess what the Government would evaluate as the "nicest to have". This researcher would recommend standardizing the RFP, ensuring the RFP contained performance specifications and clear and prioritized evaluation criteria for the "nice to have" options. Providing the construction budget and the RFP will help the contractor to develop a proposal that balances the Government's technical and financial requirements.

Recommendation 3: Several comments by the Government and contractors stated that the Government provided too much design. Every contractor interviewed said they would rather get nothing than depend on something wrong. Several examples were given of Government provided site surveys, as-built and topography that were incorrect. The problem is the Government expects, in a DB scenario, that the Contractor is liable for design errors. The Contractor states that if they are given, for example, topography that results in wrong elevations, the Government is liable. In utilizing performance specifications the Government gains the advantage of shifting the responsibility for design to the Design builder. However, if the Government elects to issue mixed specifications and provide design documents and reports, the Government impliedly warrants the design specifications, to which the design-builder must adhere. If the

Government provides sufficient detail in its furnished specification to justify the design-builders reliance on the information when pricing its proposal, the Government may be liable for any error or omission. [Ref. 9:p. 21) One contractor said their experience is that the Government expects the contractor to absorb any design cost and that their performance appraisal is held hostage. An example that this researcher experienced was having too much design in an 8(a) DB contract award that contained 95% design and prescriptive specifications. The award was made on a DB MACC to expedite the award process and for no other reason. This is not within the DB concept. This researcher recommends performance specifications and minimum design and adherence to the DB concept. The MACC DB contracts must not be used just to expedite award.

Recommendation 4: The contractors repeat what the Government eulogizes; that trusting each other is critical in the DB process. However, arbitrary design cycles do not allow the contractor to design and build within their expertise. Holding back NTP's based on design cycle hobble the DB process. This researcher recommends eliminating design cycles except for life sustaining designs such as fire control systems. This allows the contractor to exercise their expertise and synergy with their A/E of record. This recommendation should be initiated on a trial basis with a proven DB contractor.

Recommendation 5: The DB team must be together from beginning to end. While this theme is promoted, in the experience of this researcher, it is not always the case. Often in an award, the post award team only comes in after design, e.g. upon the start of the construction. This is a fatal disconnect. The team must be together from initiation. The contractors also requested that the Government retain the original DB team and not switch and substitute as this caused inefficiencies in the process. Also, the field team can make award and administer the DB contract if viable, e.g. the field team has the requisite experience. This researcher recommends a roster of all players be initiated for the DB project and everyone on that roster sign up and show up.

Recommendation 6: Several contractors testified that their successful projects were largely due to the experience that the Government team had in DB. The Government team that was experienced in the DB process facilitated the project and was

critical to its success. This researcher recommends that the Government continue offering DB course instruction.

Recommendation 7: This researcher recommends that the A/E of record, e.g. the A/E that the contractor proposed in their proposal, and the A/E that was evaluated, be the A/E for the project. This researcher has seen that in some instances, after award, the contractor switches the A/E. On one project, after award, the contractor decided that they could do the design themselves. If the Government evaluates a proposal that specifies a certain A/E of record, then that A/E must be retained through out the life of the project.

Recommendation 8: The larger projects draw the best subcontractors. The smaller contractors do not have the money to put proposals together and draw top quality A/E's. Also, the A/E's have no real expectation that the small guy will get the job so they charge the smaller contractors a higher fee and proposal costs. This researcher recommends that some compensation be considered for the non-successful participants to cover at least part of their design cost. This consideration will subsidize the smaller contractors and encourage them to compete for DB projects. Without some sort of compensation, the competition might eventually be limited to a few large participants, which will lead to reduced competition and higher costs.

Recommendation 9: Several of the prime contractors suggested that the Government builds in cost by demanding personal resumes for key personnel and requiring that the QC manager have a degree in Architecture or Engineering. The contractors often wait months pending award notification and cannot feasibly keep key personnel idly waiting to see if they will be required for the project. The contractors must move key personnel to projects as required. The researcher supports the contractor's recommendation that the salient characteristic or personal and professional requirements for QC Manager be evaluated and not the specific person. This will allow the contractor to move personal and fulfill Government requirements if awarded the contract. This researcher supports that the Government should require experienced QC management but not require a degree in Architecture or Engineering. One contractor put it succinctly, "Why would a person with a degree in either of those disciplines want to be a QC manager?" The Government will get an unsuccessful candidate in Architect and

Engineering. The contractors state that requiring experienced QC managers is key. The QC manager is supposed to be unbiased to either the contractor or the Government. The contractors state that characteristic makes a QC manager an unlikely candidate for promotion within the structure of the contractor's company. Every contractor interviewed stated that the degreed QC manager requirement is extremely difficult to fulfill and builds unnecessary cost into their proposals.

Recommendation 10: The Government should eliminate the requirement for the contractor to provide several copies of catalog cuts. This practice is tedious and wasteful. Most catalog cuts can be viewed on-line in electronic format if required. The Government should stipulate the performance and let the contractor satisfy the requirement. As an example, the Government stipulated a GE refrigerator. The GE refrigerator was shipped to HI where it was not accepted because the other refrigerators were Motorola.

Recommendation 11: This researcher recommends that renovation projects not be used as DB projects unless the contractors are allowed to do destructive inspection. Every contractor interviewed stated that renovation projects were not good candidates for DB since the contractors did not know what was hidden under roofs, walls, floorings, etc. These projects do not allow for design creativity, which is a strong suit in DB.

Recommendation 12: The data used in this research was from the FIS database. The project is built in the database inclusive of congressional appropriation limit, and project funding assignment. However, it is extremely difficult to extract the information that was used in this research. The original query provided the funding subhead and project number and description. The dollar value for award amount in the original query was listed by subhead and project. This researcher had to match the projects then to contracts. The BEQ's, for example, were listed as twenty separate projects and were listed several times depending on funding subheads, e.g. if there were more than one subhead, the project was listed again. The twenty BEQ projects resulted in eighteen contracts because some projects were combined. The naming convention was problematic in that it did not follow the same convention for the project description and the contract award description. It was also impossible to find information for projects

that were awarded by a different agency. On some projects, for example, the ACOE did the design, and the funding or award amount was impossible to retrieve. This researcher recommends that the data structure for all projects link the project number to the contract for construction so that a data query will extract the contract information with the project information. This researcher recommends that if FIS continues to be the project and financial management system that the project information and contract information be kept up to date and accurate. As an example, on one BEQ project, the contract legal completion date that was taken from the modification, was 26 April 2000, although FIS showed the legal completion date to be 5 May 2001 which was input in error. The original legal contract completion from the contract document was 5 May 2000. Crafting a database that allows management reports to reflect performance metrics is key to sound decision making.

Recommendation 13: All Government personnel, contractors, owners and occupants applauded the use of partnering. The communication and trust necessary for successful project completion requires that each project be partnered. This researcher recommends partnering for all projects.

Recommendation 14: The Government specifications should be written as performance specifications, unless detailed specifications are required for some reason. In contrast to design specifications in which the precise detail including the material to be used and the manner in which the work is to be performed, the performance specification sets forth an objective or standard to be achieved. Many of the complaints by the customer was they did not get what they wanted. In many cases this was because the objective was not successfully captured in a performance specification. The contractors also request performance specifications, to exercise their ingenuity in achieving that objective or standard of performance. The Government must ensure it authors the RFP with well written performance specifications which will ensure customer and contractor satisfaction as well as transferring the liability to the contractor who, by selecting the means to reach the objective or standard, also assumes the corresponding responsibility for that selection. This author recommends continuing training for Government personnel in performance based contracting and performance specification writing.

D. REVIEW OF RESEARCH QUESTIONS

1. Primary Research Question

Is the Design-Build construction project delivery approach a superior method of managing Navy Bachelor Enlisted Quarters construction projects?

Based on the data extracted from FIS for MCON BEQ projects awarded and completed in FY1996-2000, the researcher believes that the DB construction project delivery approach is superior based on DB's out performance of DBB in the areas of cost growth, construction cost growth, award growth and design-construct placement.

2. Subsidiary Research Questions

- What type of homogenous construction projects are representative of Naval Facilities Engineering Command, Southwest Division?

The BEQ's are highly representative of SWDIV's homogenous MCON projects. The BEQ projects represent 18% of all projects awarded from FY1996-2000 and represent 25% of the total dollar volume. Combined with family fitness centers and child care centers, the projects represent 36% of the total project types and 31% of the total dollar volume.

- What are the backgrounds and histories of Design-Bid-Build and Design-Build construction management approaches?

Design-Build is a means of combining design and construction in a single contract with one contractor. The authority to use the two-phase DB method was promulgated in FAR CASE 96-305 as a result of the enactment of Section 4105 of the Clinger Cohen Act of 1996, Public Law 104-106. Specifically, FAR subpart 36.301 prescribes policies and procedures for the use of the two-phase DB selection procedures authorized by 10 U.S.C. 2305a and 41 U.S.C. 253m. The use of the DB process for military construction projects is authorized under Title 10 U.S.C., Section 2862, with permission of the Secretary of the military department concerned.

In contrast to DB, the traditional method of using Design-Bid-Build (DBB) entails issuing an initial contract for "architect-engineer services," as defined in 40 U.S.C.541. The professional services for an A/E firm define the construction requirement. The professionals who provide these services are licensed, registered, or certified to provide

such services. Upon completion of the A/E contract, the construction contract is solicited for bid under procedures in FAR Part 14. The traditional DBB approach is established under the Brooks Architect-Engineers Act (41 U.S.C. 541, et seq.)

The first DB MCON project for SWDIV was completed in FY1996.

- What is the comparative quality performance of using DBB versus DB?

Based on the surveys returned for DBB and DB BEQ projects, the quality performance is mixed. For turnover process quality, DB outperformed DBB in the areas of starting up the facility and operations and maintenance. In the area of number of call backs, the DBB method scored higher. In the systems performance quality, DBB outperformed DB in the areas of interior space and layout, environment, and process equipment and layout. In the area of the facilities envelope, roof, structure and foundations, the DB method scored higher.

- What is the comparative cost growth in the construction contracts for projects using DBB versus DB?

In the area of construction cost growth for all projects, DB outperformed DBB projects. For the BEQ cost growth, the DBB method recorded a 12% cost growth compared to 1% for the DB projects.

- What is the comparative schedule growth in the construction contracts for projects using DBB versus DB?

The BEQ projects awarded under the DBB resulted in a 56% time growth compared to the 5% time growth for DB BEQ projects.

E. AREAS FOR FURTHER RESEARCH

The researcher proposes the following areas for further study:

- Conduct research on the effectiveness of compensating unsuccessful offerors for proposal preparation costs and its possible effect on increasing the competition pool
- Conduct research in the feasibility of using the DB method for renovation projects
- Conduct research on the impact of using Low Price Technically Acceptable Best Value evaluation on the impact of creativity that results in the DB project

APPENDIX. PROJECT DELIVERY SYSTEM QUALITY SURVEY

PROJECT DELIVERY SYSTEM QUALITY SURVEY

SECTION I: PROJECT CHARACTERISTICS

Project name:_____ Project location:_____

Project respondent title who provided data, (ex. Contract Specialist):_____

Phone number:_____

Activity/Company Name:_____

If applicable: _____Owner, _____Design-Builder, _____Architect/Designer, _____Contractor, _____Government Employee

Building gross square footage:_____ sf No of floors_____

SECTION II: PROJECT DELIVERY SYSTEM

Check the appropriate project delivery system which was used on your project:

Design-Build_____ Design-Bid-Build_____

SECTION III: PROJECT SCHEDULE PRERFORMANCE

Please provide the following **schedule** information:

Item	**Planned Date** (mm/dd/yy)	**Actual Date** (mm/dd/yy)
Date Project was advertised:	_____	_____
Design Start Date:	_____	_____

*Notice to Proceed date, NTP
Construction Start Date: _____ _____

*Construction End Date:
*Substantial Completion, UCD/BOD _____ _____

SECTION IV: PROJECT PERFORMANCE

What were the following total **project costs.**

	Design Costs	Construction Costs	Total Project Costs
Budget	_____	_____	_____
Contract Award	_____	_____	_____
Final Cost	_____	_____	_____

WHAT % OF DESIGN WAS COMPLETE WHEN THE CONSTRUCTION ENTITY JOINED THE PROJECT TEAM?_____%

SECTION V: ABOUT YOURSELF

Please provide some information about yourself and your connection to this facility. Information in this section will be used to assist NAVFAC in sorting out which "customer" groups have common concerns about the facility planning, design, construction and turnover process.

Note 1: Questions have both positive and negative wording. Be careful.
Note 2: All areas may not directly apply to you. Do the best you can.

Your connection to this facility (***check the best one):***

_____ I use this facility as living quarters.

_____ I use this facility as a workplace.

_____ I supervise or manage users of this facility.

Your involvement in the construction of this facility (***check as many as applicable***).

_____ I had no part in the planning, design, construction or maintenance turnover of this facility.

_____ Participated in planning phase (before facility was funded).

_____ Participated in design phase (after facility was funded).

_____ My main job is to maintain this

_____ I supervise or manage maintainers of this facility.

_____ I use this facility only as a guest or customer. *Not employed here or living here.

_____ Other (please explain):

_____ Participated in construction phase facility. (interacted with ROICC on construction issues or changes).

_____ Participated in maintenance turnover Phase (turnover from ROICC after construction).

_____ Received training in maintenance of facility from ROICC or Contractor.

SECTION VI: PROJECT TEAM CHARACTERISTICS

Please check the block that applies to the attributes of your project team.

Individual experience of members with similar facilities:

Owner's Representative	**_____Excellent**	**_____Limited**	**_____None**
Design-Builder	**_____Excellent**	**_____Limited**	**_____None**
Architect/Designer	**_____Excellent**	**_____Limited**	**_____None**
Contractor	**_____Excellent**	**_____Limited**	**_____None**
Subcontractors	**_____Excellent**	**_____Limited**	**_____None**

Individual experience of members using your project's delivery system:

Owner's Representative	**_____Excellent**	**_____Limited**	**_____None**
Design-Builder	**_____Excellent**	**_____Limited**	**_____None**
Architect/Designer	**_____Excellent**	**_____Limited**	**_____None**
Contractor	**_____Excellent**	**_____Limited**	**_____None**
Subcontractors	**_____Excellent**	**_____Limited**	**_____None**

Team's prior experience as a unit: **_____Excellent _____Limited _____None**

Project team communication: **_____Excellent _____Limited _____None**

Project team chemistry: **_____Excellent _____Adequate _____Poor**

Owner type: **_____Public _____Private**

Owner-project team relationship: **_____First Time _____Partnering _____Repeat**

Owner representative's capability _____**Excellent** _____**Adequate** _____**Poor**

Owner's ability to define scope: _____**Excellent** _____**Adequate** _____**Poor**

Owner's ability to make decisions: _____**Excellent** _____**Adequate** _____**Poor**

Project complexity: _____**High** _____**Average** _____**Low**

Regulatory/legal constraints: _____**Many** _____**Few** _____**None**

Onerous contract clauses: _____**Numerous** _____**Several** _____**None**

SECTION VII: PROJECT

Please check the block that applies to the appropriate category to identify the appropriate systems and/or descriptors that apply to your project:

FOUNDATION:

_____Slab on grade with spread footings
_____Caissons, piles or slurry walls
_____Mat foundation
_____Other;

STRUCTURE:

_____Pre-engineered metal building
_____Bar joists or precast planks on bearing walls
_____Steel frame and metal deck
_____Precast concrete frame and decks
_____Cast-in-place concrete structure
_____Complex geometry/mixed framing types
_____Other:

EXTERIOR ENCLOSURE:

_____All glass curtain wall
_____CMU, brick, or stone
_____Cast-in-place exterior walls
_____Metal panels
_____Precast panels
_____Other:

ROOFING:

_____Asphalt shingle
_____Built-up/single-ply membrane
_____Other:
_____Steep roof with tile/slate
_____Architectural standing seam

HEATING/COOLING:

_____Roof top units
_____Heating only
_____Other:
_____Central plant
_____Cooling only
_____Split system
_____Ventilation only

ELECTRICAL:

_____Uninteruptable power supply _____Electric heat
_____General lighting and computer use _____Intensive computer use
_____Process equipment loads _____Security system

CONTROLS:

_____Direct digital controls _____Pneumatic controls
_____Other:

SITE:

_____Urban _____Suburban _____Rural
_____Existing Utilities _____Existing Roads _____Mass excavation
_____Other:

SECTION VIII: PROJECT QUALITY PERFORMANCE

Please check the block to evaluate **quality** of the building:

Difficulty of facility startup:

_____ **High** _____ **Medium** _____ **Low**

Number and magnitude of call backs:

_____ **High** _____ **Medium** _____ **Low**

Operation/maintenance cost for building/site:

_____ **High** _____ **Medium** _____ **Low**

Did the quality of envelope/roof/structure/foundation meet your expectations?

_____ **Exceeded** _____ **Yes** _____ **No**

Did the quality of interior space/layout meet your expectations?

_____ **Exceeded** _____ **Yes** _____ **No**

Did the quality of environmental systems (light, HVAC) meet you expectations?

_____ **Exceeded** _____ **Yes** _____ **No**

Did the quality of process equipment/layout meet your expectations?

_____ **Exceeded** _____ **Yes** _____ **No**

Please indicate by checking the block whether you strongly agree (SA), agree (A), or strongly disagree (SD) with the corresponding statements about the **facilities ability to support your mission**. Please leave blank if you have no opinion/don't know/ or the question does not apply.

Facility seems well suited to our mission.

_____ **SA** _____ **A** _____ **SD**

Visitors in this facility can find their way around easily.

_____ **SA** _____ **A** _____ **SD**

Installed equipment is **not** appropriate for this facility.

_____ **SA** _____ **A** _____ **SD**

Kitchen is well suited to our needs.

_____ **SA** _____ **A** _____ **SD**

Facility floor plan is compatible with our organization.

_____ **SA** _____ **A** _____ **SD**

Furnishings make the spaces more pleasing to work in.

_____ **SA** _____ **A** _____ **SD**

Telephone receptacles conveniently placed.

_____ **SA** _____ **A** _____ **SD**

Facility supports our computer usage.

_____ **SA** _____ **A** _____ **SD**

There are **not** enough electrical outlets for all the equipment we use.

_____ **SA** _____ **A** _____ **SD**

Workspace-to-workspace movement is quick and easy. (When I need to go see somebody else in the facility, I can get there conveniently.)

_____ **SA** _____ **A** _____ **SD**

Electrical capability can be expanded without major modifications of facility.

_____ **SA** _____ **A** _____ **SD**

Facility is flexible enough to meet changing needs.

_____ **SA** _____ **A** _____ **SD**

Comments:_____

_____

_____

_____

_____

_____

_____

_____

SECTION IX: ENVIRONMENTAL ISSUES

Please indicate by checking the block whether you strongly agree (SA), agree (A), or strongly disagree (SD) with the corresponding statements.

There is a problem with indoor air quality.

_____ **SA** _____ **A** _____ **SD**

Hazardous Materials can be managed safely in this facility.

_____ **SA** _____ **A** _____ **SD**

Trash collection is a problem inside this facility.

_____ **SA** _____ **A** _____ **SD**

Storage of cleaning equipment and materials is **not** a problem.

_____ **SA** _____ **A** _____ **SD**

It's hard to keep this facility looking squared away inside.

_____ **SA** _____ **A** _____ **SD**

Facility orientation (way it faces onsite) uses sun, shade and prevailing wind to best advantage.

_____ **SA** _____ **A** _____ **SD**

Comments:_____

SECTION X: QUALITY OF LIFE IN YOUR FACILITY

Please indicate by checking the block whether you strongly agree (SA), agree (A), or strongly disagree (SD) with the corresponding statements.

Heating and air conditioning make facility comfortable to work in.

_____ **SA** _____ **A** _____ **SD**

Facility is conveniently accessible for visitors.

_____ **SA** _____ **A** _____ **SD**

Facility is conveniently accessible for occupants.

_____ **SA** _____ **A** _____ **SD**

It is easy for disable persons to get around in this facility.

_____ **SA** _____ **A** _____ **SD**

Disabled persons can operate all necessary functions of facility.

_____ **SA** _____ **A** _____ **SD**

Lighting in facility is adequate.

_____ **SA** _____ **A** _____ **SD**

Spaces proved the work privacy we need.

_____ **SA** _____ **A** _____ **SD**

This facility is too noisy.

_____ **SA** _____ **A** _____ **SD**

Attention to detail in construction is evident.

_____ **SA** _____ **A** _____ **SD**

Material finishes are appropriate to overall purpose of facility.

_____ **SA** _____ **A** _____ **SD**

Little things, like doorknobs, switches, faucets, etc., do **not** seem to work or fit.

_____ **SA** _____ **A** _____ **SD**

SECTION XI: SAFETY IN YOUR FACILITY

Please indicate by checking the block whether you strongly agree (SA), agree (A), or strongly disagree (SD) with the corresponding statements

Exterior lighting provides adequate security for users of facility.

_____ **SA** _____ **A** _____ **SD**

Facility design enhances physical security.

_____ **SA** _____ **A** _____ **SD**

All exit lights are clearly marked and easily accessible.

_____ **SA** _____ **A** _____ **SD**

Fire alarms are accessible and audible throughout the facility.

_____ **SA** _____ **A** _____ **SD**

Disabled persons will have trouble getting out of facility.

_____ **SA** _____ **A** _____ **SD**

Design of facility enhances safe operating conditions.

_____ **SA** _____ **A** _____ **SD**

Safety systems for occupational hazards are readily available.

_____ **SA** _____ **A** _____ **SD**

Comments:_____
_____
_____

SECTION XII: APPEARANCE OF YOUR FACILITY

Please indicate by checking the block whether you strongly agree (SA), agree (A), or strongly disagree (SD) with the corresponding statements.

Facility looks good.

_____ **SA** _____ **A** _____ **SD**

Facility fits well with overall appearance of base (size, design and color).

_____ **SA** _____ **A** _____ **SD**

Interior design enhances work environment.

_____ **SA** _____ **A** _____ **SD**

Landscaping looks good.

_____ **SA** _____ **A** _____ **SD**

Main entry is pleasing, inviting way into facility.

_____ **SA** _____ **A** _____ **SD**

This facility is award caliber.

_____ **SA** _____ **A** _____ **SD**

Comments:_____
_____
_____
_____

SECTION XIII: MAINTENANCE OF YOUR FACILITY

Please indicate by checking the block whether you strongly agree (SA), agree (A), or strongly disagree (SD) with the corresponding statements.

Roof has a problem with leaks.
_____ **SA** _____ **A** _____ **SD**

Windows seal tightly against weather.
_____ **SA** _____ **A** _____ **SD**

Ventilation system is quiet.
_____ **SA** _____ **A** _____ **SD**

Air conditioning ducts drip.
_____ **SA** _____ **A** _____ **SD**

Doors operate smoothly.
_____ **SA** _____ **A** _____ **SD**

Windows operate smoothly.
_____ **SA** _____ **A** _____ **SD**

Training received in maintaining this facility was about right.
_____ **SA** _____ **A** _____ **SD**

Heating and air conditioning are too hard to operate.
_____ **SA** _____ **A** _____ **SD**

We know what to do when something goes wrong with heating and air conditioning.
_____ **SA** _____ **A** _____ **SD**

Plumbing works well.
_____ **SA** _____ **A** _____ **SD**

Manuals received are clear and useful in maintaining facility systems.
_____ **SA** _____ **A** _____ **SD**

Equipment is easy to access.
_____ **SA** _____ **A** _____ **SD**

We put in trouble calls frequently on this facility.
_____ **SA** _____ **A** _____ **SD**

Facility contractor did a good job of responding to problems.
_____ **SA** _____ **A** _____ **SD**

Material finishes are easy to maintain.

_____ **SA** _____ **A** _____ **SD**

Facility grounds are easily maintained.

_____ **SA** _____ **A** _____ **SD**

Planned maintenance budget supports facility.

_____ **SA** _____ **A** _____ **SD**

Comments:_____
_____
_____
_____
_____
_____
_____

SECTION XIV: COORDINATION AND COMMUNICATION WITH NAVFAC SOUTHWEST DIVISION

Please indicate by checking the block whether you strongly agree (SA), agree (A), or strongly disagree (SD) with the corresponding statements.

NAVFAC handled planning process well.

_____ **SA** _____ **A** _____ **SD**

NAVFAC handled design process well.

_____ **SA** _____ **A** _____ **SD**

NAVFAC handled construction process well.

_____ **SA** _____ **A** _____ **SD**

NAVFAC handled maintenance turnover process well.

_____ **SA** _____ **A** _____ **SD**

NAVFAC used our input during design process.

_____ **SA** _____ **A** _____ **SD**

ROICC was responsive to our concerns during construction process.

_____ **SA** _____ **A** _____ **SD**

Partnering during construction was a useful experience.

_____ **SA** _____ **A** _____ **SD**

Acquisition strategy decision should have involved customer more.

_____ **SA** _____ **A** _____ **SD**

Coordination and Communications comments:

OVERALL IMPRESSION

How satisfied are you with the **quality** of this facility?

_____Highly Satisfied _____Satisfied _____Highly Dissatisfied

What are the **Best** things about this facility?

1._____

_____

2._____

_____

3._____

_____

4._____

_____

5._____

_____

What are the **Worst** things about this facility?

1._____

_____

2._____

_____

3._____

_____

4._____

_____

5._____

_____

How satisfied are you with the NAVFAC facility delivery process?

_____Highly Satisfied _____Satisfied _____Highly Dissatisfied

What was **BEST** about the process?

1._____

_____

2._____

_____

3._____

_____

4._____

_____

5._____

_____

What was **Worst** about the process?

1._____

_____

2._____

_____

3.

4.

5.

If you could influence NAVFAC to strengthen, change, or modify an existing service or offer new service; what would you propose?

Thank you for your time and thoughtful responses!

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LIST OF REFERENCES

1. Adamson, Jerry, ASLA, "Design-Build is Growing" *The Military Engineer*, January – February 2001, No. 609, pp. 19-20, 2001.

2. Askari, Hasan A., "Critical Issues in Design-Build Construction Contracts" *Contract Management*, pp. 4-9, September 1999.

3. Ashton, LT Steven W. and Tierno, M., "Points to Remember," *The Military Engineer*, No. 609, pp. 25-26, January-February 2001.

4. Crammer, Mark, "Design-Build in the Corps of Engineers, A work in Progress," *The Military Engineer*, January – February 2001, no. 609, pp. 21-22, 2001.

5. Ellis, Ralph, Herbsman, Z., Kumar, A., "Evaluation of the FDOT Design/Build Program", Department of Civil Engineering, College of Engineering, University of Florida, U.F. No. 4910450433012, p. 39, August 1991.

6. Fair, Jim, "Design-Build Ideas lead a Non Design-Build Project to Success," *The Military Engineer*, January- February 2001, No. 609, pp. 27-28, 2001.

7. Gransberg, Douglas, "The Cost of Inaction: Does Massachusetts Need Public Construction Reform?", *Pioneer Institute*, http://www.pioneerinstitute.org/research/whitepapers/wp7cover.ctm/, pp. 10-15, June 14, 2001.

8. Hunt, Gordon and Darling, John, "the Allocation of Risks in a Design/Build Construction Project", Los Angeles Lawyer, pp. 21-25, 52-53, January 1999.

9. Konchar, M. and Sanvido, V. (1998). "Comparison of U.S. Project Delivery Systems," *Journal of Construction Engineering and Management*, pp. 86, 97-99, 435-439, November-December 1998.

10. Molenaar, Keith, Design-Build Selector Predictive Tool, http://www.Colorado.EDU/engineering/civil/db/ September 9, 2001.

11. Molenaar, Keith, Ellis, R., "Washington State Department of Transportation, Design-Build Project Evaluation, Interim Report-Evaluation Work Plan, The University of Colorado at Boulder, Civil, Environmental and Architectural Engineering, November 1999.

12. News Release from the United States Department of Defense, http://www.defenselink.mil/news/releases.html, September 15, 2001.

13. Ricker, Greg and Golden, David, Harper Construction Company, Inc., Interview by author, June 20, 2001.

14. Rosenbaum, D. B., "Can't We All Just Get Along?" *Engineering News Record*, 235 (16), p. 13.

15. Songer, A. D. and Molenaar, K. R., "Selecting Design-Build: Private and Public Sector Owner Attitude," ASCE *Journal of Engineering Management*, Vol. 12, No. 6, pp. 47-53, November 1996.

16. SOUTHDIV, Design-Build Manual, http://www.efdsouth.navfac.navy.mil/designbuild/, September 9, 2001.

17. Ward, James, http://home.earthlink.net/~cptnjimbunn/Dbprocess.htm, March 26, 2000.

18. Ward, James, http://iw/PDF/DesignBuild.pdf, September 9, 2001.

19. Wolfe, Steve, Deputy Public Works Officer, Camp Pendleton, CA, Interview by author, April 17, 2001.

20. Wylie, Ed., Owner, C. E. Wylie Construction, Co., Interview by author, March 13 and 20, 2001.

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